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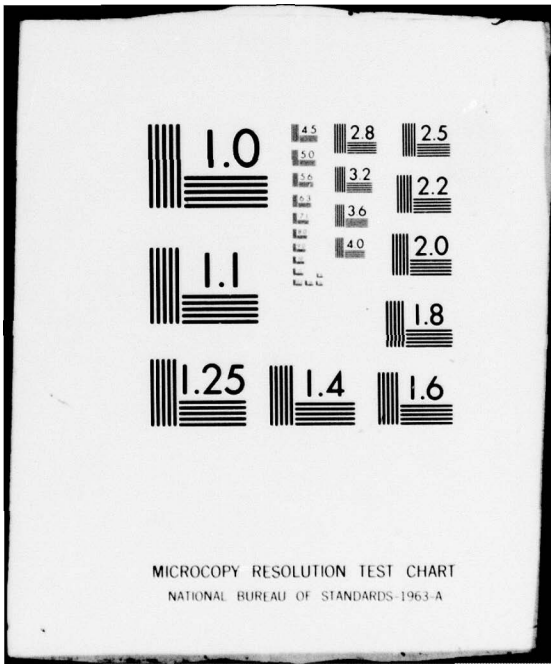
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Technology Transfer and Government Patent Rights

The *Defense Systems Management Review* is published quarterly by the Defense Systems Management College, Fort Belvoir, Va. 22060, and is intended to be a vehicle for the transmission of information on policies, trends, events, and current thinking affecting program management and defense systems acquisition.

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DEFENSE SYSTEMS MANAGEMENT REVIEW

Technology Transfer and Government Patent Rights

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FOREWORD

Rear Admiral Rowland G. Freeman III
Commandant,
Defense Systems Management College

This issue of the *Review* is devoted to the subject of technology transfer and some of the difficult problems associated with it. Technology transfer has always been a rather controversial issue, particularly if it involves transfer to foreign countries. In many cases it has become a highly emotional issue as well, an issue that must be resolved at the policy-making level.

The articles in this issue deal primarily with the pragmatic concerns and difficulties in effecting transfer actions, and generally presume that there is a desire to effect such transfer, and that the transfer has been approved. Regrettably, there are some people who believe that transferring technology means bundling up a package of something and giving it to somebody else, thereby concluding the process. Such is not the case. Technology transfer is a long-term process, and its difficulties could span the entire spectrum of basic research, exploratory development, advanced development, applied engineering, prototyping, testing, manufacturing processes, etc. Technology transfer can also be likened to the process of osmosis—it takes time, training, understanding, effective communication and continual dialogue. Even after that, the transfer may not be fully effective.

Although little public attention is focused on the efforts made within the Department of Defense for *domestic* technology transfer, we have had major programs in being for a number of years to insure that, wherever feasible, we transfer the technology developed in our defense activities to the civilian community, as well as to industry. The list of successes in these efforts is a long one and includes examples in the fields of electronics, health care, manufacturing, personnel management, acquisition management and many others. An acquisition manager, among his other responsibilities, must be aware of what is involved in the transfer of technology to foreign and domestic sources including such issues as intelligence, property rights, and the definition of critical technology. I think you will find that the articles herein illustrate these problems and provide some insight into their possible resolution.

As noted in our Autumn 1978 edition, the Defense Systems Management Review *is undergoing a period of accelerated evolution, with the most obvious indicator of change being the revised format. This evolution will continue at a rapid pace for the next several issues as we further develop our ideas and perform the necessary fine-tuning. One idea we hope comes to fruition is the inclusion of a "correspondence" section in each issue, a section devoted to comments from our readers. We foresee the correspondence section as a forum for you to either concur or take issue with ideas put forth by* Review *authors, or to comment on other important issues in defense systems acquisition. With the proper response, this could become one of the most enlightening and thought-provoking parts of the* Review. *We encourage your participation.*

7 TECHNOLOGY TRANSFER: A KEY TO PRODUCTIVITY

James A. Higgins

There is a growing concern with lagging productivity in this country and its effect on the general welfare of our people. Those who routinely read the business and/or technical literature have been inundated with explanations and theories as to why our businesses do not compete well in the international marketplace—too much government regulation, not enough R&D, excessively powerful labor unions, poor management, restrictive patent policies, regressive taxes, etc.—the list is endless. One would suspect, however, that all of these contribute in one way or another to our productivity problem.

The problem is doubly disturbing when one considers that technology and production engineering have always been the United States' strong suits. It could be argued that the United States is the major source of new invention and innovation in the world today. Since 1945 the two productivity-troubled countries, Great Britain and the United States, have won 70 percent of the Nobel Prizes for science, and the United States is credited with over 60 percent of all the major technological innovations discovered in the past 25 years.[1] Much of the R&D has been directed toward military- or space-oriented projects, however, and perhaps too little toward the commercial sector.

It is not the intent of this paper to suggest that either basic or applied research is receiving too much attention in the United States. In fact, those nations that support R&D appear to be more successful in the world market than those who do not. Fortunately, the current Administration is reemphasizing the need to stimulate new research and to reverse the current trend. Still, there does seem to be an imbalance between our ability to develop new technology and our ability to utilize the technology in the commercial marketplace. That is the point to be made— we need to emphasize more strongly how to apply or transfer new technology into the commercial marketplace. Japanese and German manufacturers have developed great skill in bringing U.S.-developed technology into commercial use, then selling the product in the U.S. market—automobiles, solid-state electronics, ships and, before long, computers, chemicals, etc.

Innovations and inventions that are successfully introduced into the commercial world marketplace appear to require several discrete skills—innovative or inventive

1. "The Science Olympics," *The Economist*, May 20, 1978.

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skills, production and marketing skills, and the business skills necessary to accumulate the capital required for the research and production to take place. In terms of personnel, these skills are generally represented by groups having different interests, motivations, education, and approaches to business. Far more ideas fail than succeed as a result of clashes between and among these three resource groups. Many mechanisms have been developed by large corporations and the government to overcome this difficulty and coordinate these groups into a total effort. Unfortunately, although team concepts and program manager organizations have been developed in large organizations, small organizations and individuals still provide the bulk of marketable innovations and inventions in this country.

Figure 1 attempts to describe a simple logic in the development of a new, commercially viable product. In the United States we understand each of these three resource areas when considered separately, but the interactions of the three are most difficult to comprehend. Making this system work requires careful organizational planning, but more important are the people who act as "linking chains" between these three groups. This is what technology transfer is all about—bringing the innovative, financial, and production resources together in a working arrangement.

Figure 1

Agriculture Technology Pool

Probably the most successful technology development and transfer system ever developed for commercial use has been in American agriculture. Starting with the land-grant college program at the turn of the century, the government set in motion a vast technology development and transfer system that has had fantastic results. The agricultural technology pool is created through research grants to universities by government and industry, but the most ingenious and effective piece in the operation is the county agent system. The county agents feed new information to the farm interests in one direction and send the farmers' technology problems to the R&D establishment in the other direction. Agricultural productivity in the United States continues to be a technological phenomenon. There is little doubt that the county agent is extremely important and effective as the technology transfer agent.

In the Federal Government, three relatively new groups have mounted a comparatively modest effort to assist the private sector in the utilization of technology: The National Science Foundation; The Experimental Technology Incentives Program, National Bureau of Standards; and The Commission on Productivity and Quality of Work Life. The National Science Foundation has supported a number of basic studies in the area of technology, and most importantly, has assisted the universities in establishing a more formal understanding of the process. The Experimental Technology Incentives Program (ETIPS) has enjoyed success in a more pragmatic sense. Although a small effort in terms of dollars and manpower, ETIPS has used the Federal procurement system to move in the direction of more energy efficient equipment. Unfortunately, The Commission on Productivity and Quality of Work Life encountered difficulty and was phased out in September 1978.

The Maritime Administration (MarAd) established an R&D program in the 1969/1970 period largely based on the premise that substantial technology existed in the United States, but was not being fully utilized by the maritime industry. The assumption has proven to be essentially correct. The governmental effort has been effective in transferring existing technology to and among the shipbuilding companies, ship-operating companies, and port authorities in the United States.

There are currently twelve R&D program areas in the MarAd program (the National Shipbuilding Research Program is described in detail in *Case Studies in Maritime Innovation*[2]). These programs are cost-shared with industry, and the projects have been judged by various independent reviewers to have a high rate of implementation and adoption by private industry users. A recent cost/benefit analysis by MarAd indicates that by concentrating on the technology transfer aspects of the R&D Program, the ultimate use of the research can be at least doubled. This translates directly into increased productivity and cost savings.

Growing National Need

In summary, there is a growing national need to increase and utilize new and existing technology in a way that will increase national productivity. There are existing practical, academic, government, and industrial models reflecting the ways technology transfer techniques can be applied to accomplish this task. At the risk of recommending that the Federal Government assume another responsibility, this problem, like energy, would seem to be of national significance, requiring a national solution. The President's Science Advisor's Office would be an ideal candidate to examine the problem and to recommend an organizational approach toward full utilization of technology transfer techniques to increase national productivity and protect the quality of life in the United States. ‖

2. *Case Studies in Maritime Innovation*, Maritime Transportation Research Board, National Academy of Sciences, May 1978.

TRENDS IN FEDERAL PATENT POLICY

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Franz O. Ohlson, Jr.

Although for the past 30 years Federal patent policy has been developing along separate paths in the executive and legislative branches of government, those paths appear today to be leading in the same direction—toward a greater recognition of patent rights and incentives.

This unity of direction is extremely important to the Federal acquisition process and to the technological base of our nation. Government awareness of the need to stimulate and protect creativity helps to assure continued industrial innovation and growth. While the executive and legislative branches are now apparently both moving the same way, the history of patent policy in this country is one of differing views on this major economic issue.

Patent Rights

The Constitution grants to the Congress the power to "promote the progress of...useful arts, by securing for limited times to...inventors the exclusive right to their...discoveries" (Art. I Sec. 8 C1. 8). Contrary to popular belief, a patent does not give its owner perpetual exclusive right to make, use, or sell the patented invention. Rather, the owner receives the right to exclude others for a limited period—17 years—from making, using, or selling the patented invention. In some cases a patentee may be unable to market the patented invention because of another prior dominating patent. For example, a patent may cover an improvement on an earlier patented invention. Here, in order to make, use, or sell his patented product, the later patent-owner must either obtain a license from the prior owner of the dominating patent, or must wait until such patent expires. Also, a patent owner, by statute (28 USC 1498), may not stop the unlicensed use of his patent by or for the U.S. Government; he may only take action against the United States in the U.S. Court of Claims in order to recover reasonable and entire compensation.

Federal Patent Policy and Patent System Incentives

Over the years, those in government and industry involved in the patent field have kept in mind the stated constitutional purpose of our patent system. The patent system was created for the benefit of the public, offering the incentive of patent protection to the inventor of a product in order to induce a complete disclosure of the invention to the public. In the absence of a patent system, immediate public disclosure of an invention would leave the invention unprotected. This would

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encourage secrecy, which would, in turn, stifle technological progress since progress is achieved most efficiently by building on previous knowledge.

The incentives and benefits of the American patent system were summarized in the Report of the President's Commission on the Patent System (1966) as follows:

> Agreeing that the patent system has in the past performed well its Constitutional mandate "to promote the progress of...useful arts," the Commission asked itself: What is the basic worth of a patent system in the context of present day conditions? The members of the Commission unanimously agreed that a patent system today is capable of continuing to provide an incentive to research, development, and innovation. They have discovered no practical substitute for the unique service it renders.

The Commission also found that a patent system:

- Provides an incentive to invent by offering the possibility of reward to the inventor and those who support him;
- Stimulates the investment of additional capital for the further development and marketing of the invention;
- Encourages early public disclosure of technological information, some of which might otherwise be kept secret; and,
- Promotes the beneficial exchange of products, services, and technological information by providing protection for industrial properties.

It is these incentives for private investment and the encouragement of competition in research and development provided by our patent system that serve to advance technology and bring the fruits of such efforts to the public. A patent is a commercial, competitive tool which serves the public and achieves the goal set out by the Constitution to advance technology for the public good.

In general, industry believes that, as distinguished from a patent in the hands of an individual or company competing in the marketplace, a patent in the hands of the government removes the incentive and encouragement of competition offered by our patent system. In a democracy based on the free-enterprise system, the government should not be involved in, or compete for a share of, the marketplace, and therefore should not use the patent as a competitive tool. The government's principal interest should be to assure that patented inventions are brought to the public to meet public needs to the greatest possible extent. It would be an anomaly indeed if the government, holding a patent for the public good, were to bring suit against an alleged infringer in order to preclude the public from benefiting from the patented invention.

There is some question as to whether government ownership of patents is possible. Or, when the government does acquire a patent, is the legal effect to extinguish the rights granted by the government in the patented invention?*

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*See Frank J. White, "Government Ownership of Patents," *Fordham Law Review*, Vol. XII, No. 2, May 1943; and *Contra*, Howard I. Forman, *Patents—Their Ownership and Administration by the United States Government*, Central Book Company.

No Uniform Federal Patent Policy

Currently, there is no uniform Federal patent policy governing the allocation of rights to inventions and any patents granted thereon when they are made in the performance of government contracts. As noted previously, the Executive and the Congress have expressed different policies. These policies fall within two general categories: (1) a "title policy," under which the government acquires title to the inventions and patents made under a government contract, with the contractor retaining a royalty-free, non-exclusive license therein, and (2) a "license policy," under which the contractor retains title, with the government acquiring a royalty-free, non-exclusive license. Additionally, there is no uniform Federal policy as to the appropriate recognition and protection of privately developed inventions and patents.

Development of a Federal patent policy began in 1943 when President Franklin D. Roosevelt instituted a study to determine whether such a policy was needed. About 4 years later, the Attorney General issued a report which, although finding that the government needed no more than a license to use inventions made under government contracts, recommended that, "[a]s a basic policy, all contracts for research and development work financed with Federal funds should contain a stipulation providing that the government shall be entitled to all rights to inventions produced in the performance of the contract...." The Attorney General's recommendation for a "title policy" was not accepted in all areas of the government. In fact, the Secretary of the Navy, the Secretary of War, former Under Secretary of War, and the Director of the Office of Scientific Research and Development, all provided strongly worded statements against the Attorney General's recommendation. Moreover, the Presidential Air Policy Committee, appointed in 1947 by President Truman, issued a report concluding that to follow the Attorney General's recommendation "would turn research and development brains from government developments to commercial and industrial developments...." The Congressional Air Policy Board, which was a joint committee of the 80th Congress, in 1948 indicated that all rights and inventions arising under research or development contracts and relating directly to a contractor's normal line of endeavor should remain with the contractor, subject to a free, non-exclusive, non-transferable license in favor of the government, and that those inventions not so related should be subject to negotiation.

A little more than 25 years after the Attorney General's report, President John F. Kennedy addressed the issue of a Federal patent policy. Under the direction of Dr. Jerome Weisner, the President's Special Assistant for Science and Technology, a Presidential Memorandum and Statement of Government Patent Policy was issued on October 10, 1963. This policy, which was applicable to all Federal agencies not otherwise governed by statute, is, in effect, a flexible policy accommodating both the title and license concepts.

It provides that, where a contract is directed toward certain matters, for example, to create, develop, or improve a product intended for commercial use by the general public, or which will be required for use by government regulation, or for exploration into fields directly concerning public health, safety, or welfare, the government normally takes exclusive rights or title. The contractor retains a non-exclusive, royalty-free license. However, a provision is made for the government, in exceptional circumstances, to waive title to the contractor if that is determined to be in the public interest. On the other hand, if the contract is to build on existing technology in a field where the contractor has an established, non-governmental, commercial position, the contractor retains title to inventions, and the government acquires a non-exclusive, royalty-free license. The public is protected by appropriate "march-in rights" under which the government may require the granting of a license to a responsible applicant when it is in the public interest to do so, or when the contractor has failed to bring the patented invention to the public. Thus, the Presidential statement of 1963 is in part a license policy modified to protect the public by providing appropriate march-in rights.

In 1971, President Nixon, acting upon the advice and recommendations of the Federal Council for Science and Technology, revised the President's patent statement, principally for the purposes of enlarging the authorization of the heads of Federal agencies to waive the government's title to inventions, and to authorize the exclusive licensing of patents owned by the government. This revision of policy had two effects: one beneficial, in that it recognized that commercialization of patented inventions is more likely to occur when title is left with the contractor than when such patents are held by the government; the other negative, in that whereas a contractor normally retained an irrevocable license, under the revised policy that license could be revoked, at least to the extent necessary to grant an exclusive license under the patented invention.

Thus, we see that although it appeared in 1947 that a title policy was imminent, by 1971 a Presidential policy had evolved that was sufficiently flexible to include both the license and title concepts. We can also see that the trend appears to be toward having title to inventions remain with the contractor, or to waive title to the contractor, apparently on the premise that in this manner the possibility of commercial utilization of the invention is enhanced.

As to congressional activity, in 1950 the Congress, in creating the National Science Foundation (NSF), declared a patent policy under which title to inventions made in research and development contracts would be disposed in a manner calculated to protect the interests of both the public and the contractor. Thus, NSF policy was neither title nor license. Very shortly thereafter, however, in the Atomic Energy Act of 1954, the Congress specifically promulgated a title policy which provided that the government could, under certain circumstances, waive title to the

contractor. Additionally, the Atomic Energy Commission was empowered to license patents held for the government. Then Congress, speaking through the National Aeronautics and Space Act of 1958, again enunciated a title policy, but also authorized the NASA Administrator to waive the government's title, again in the public interest. Here too, NASA was authorized to grant licenses under government-owned patents. From 1958 to 1965, congressional patent policies were promulgated principally through appropriation acts, which provided that inventions or patents arising from the performance of the funded contracts were to be made freely available to the public. This direction by the Congress was interpreted by the Federal agencies as expressing a title policy. It could have been implemented just as easily and correctly, however, by allowing the contractor to retain title under the stipulation that non-exclusive, royalty-free licenses of the inventions or patents would be granted to any responsible applicant seeking to bring the invention to the public. In 1974, Congress, in enacting the Federal Non-Nuclear Energy Research and Development Act, included a title policy, but also provided both specific and general guidelines under which the government could waive title to the contractor.

The most recent expression of patent policy by the Congress was set forth in legislation proposed by Congressman Ray Thornton (D., Ark.), H.R. 6249—later re-introduced as H.R. 8596 with 13 cosponsors. This legislation, which died in committee in the last Congress, proposed a license policy allowing the contractor the option of retaining title to an invention made under government contracts by filing a patent application thereon. To protect the public interest, the bill would have provided appropriate march-in rights to be exercised by a responsible member of the public after a limited period of exclusivity, or in the event the original contractor failed to bring the patented invention to the public.

Thus, we see that since 1950, congressional activity in promulgating Federal patent policy has varied, but now appears to be leading toward a license policy as set forth in the Thornton bill. This at least affords the contractor the opportunity to retain title.

An important facet of Federal patent policies is the recognition of privately developed inventions and patents. Here too, there is no uniform Federal policy. This is a serious problem, because just as in some cases a title policy diminishes competition for government research and development contracts by jeopardizing an existing privately developed patent system, so do government statutes or regulations requiring the mandatory licensing of privately developed inventions and patents have a chilling effect on competition and private investment in research and development.

In the executive branch, the Presidential patent policy statements are silent as to the compulsory or mandatory licensing of privately developed inventions and patents, often called "background patents," where they precede and dominate

inventions made under government contracts. Federal agencies, however, have not been silent on this matter. For example, legislation which requires that patented inventions funded under a Federal act be made freely available to the public has caused one agency, the Department of Interior, to require the mandatory licensing of a contractor's background patents—at least insofar as such licensing is necessary to carry out the work performed under a contract of that department. The Energy Research and Development Administration (ERDA), now in the Department of Energy (DOE), also felt obliged to include in its procurement regulations provisions for the mandatory licensing of background patents. It may be said, on the optimistic side, that in both cases the agencies have acted in good faith, and have sought to reduce to a minimum the adverse impact of mandatory licensing.

Regarding the issue of mandatory licensing in the Congress, the Atomic Energy Act of 1954 requires the mandatory licensing not only of background patents, but any patent useful in the production or utilization of special nuclear materials or atomic energy. The act also contains provisions meeting the Constitutional mandate of due process. The Clean Air Act also contains provisions for the mandatory licensing of privately owned patents, but here, too, there must be a finding that such licensing is in the public interest, and the patent owner must receive fair and reasonable compensation for the dilution of his patent rights.

In the case of the Federal Non-Nuclear Energy Research and Development Act of 1974, Congress did not mandate compulsory licensing but, as noted earlier, Federal agency implementation of the act nevertheless did require it. Congress in this instance directed ERDA/DOE to make recommendations to Congress on mandatory licensing. A colloquium held by ERDA in January 1976 on the subject of mandatory licensing resulted *inter alia* in an interim recommendation by the ERDA administrator that "[t]he complex questions of whether compulsory licensing authority is desirable for the benefit of private and other non-federally related parties requires further study, which ERDA intends to carry out and report on in the future." It is understood that DOE is still working on a recommendation to Congress as to the need for statutory authorization for compulsory licensing to meet energy needs.

On several occasions, legislation has been introduced for the specific purpose of requiring mandatory licensing of privately owned patents in certain fields. The latest such proposed legislation is H.R. 7780 introduced by Congressman John F. Seiberling (D., Ohio). Congress has not yet passed legislation of this type.

In summary, from the optimist's viewpoint, the trend of both the executive and legislative branches with respect to mandatory licensing of privately developed patents is to recognize, to the extent possible, the rights of the patent owner and to require mandatory licensing only when in the public interest and with just compensation to the patent owner. ‖

PATENTS AND TECHNOLOGY TRANSFER

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William O. Quesenberry

World War II disturbed the tranquility of science and technology. Prewar Federal sponsorship of about $40 million a year in research and development has now exploded to the point that three times that amount in tax dollars is spent *each day* in the current fiscal year. In doing so, the Federal Government supplies the bulk of research and development funds to the U.S. economy. To bring the matter a little closer to home, half of this Federal R&D outlay is represented by the eleven-plus billion dollars allocated to defense research and development.

Research and development sponsorship has produced, particularly within the military departments, a vast amount of new technology. This technology has served the defense establishment well in its mission to develop and acquire the weapon systems and materiel necessary for the defense of the nation. Large defense and aerospace contractors have transferred aircraft, air control and safety, computer, and similar technology from the military sector to the civilian sector. Beyond that, there seems to have been little additional return on investment to the taxpayer in terms of use of this accumulated technology by private industry in its pursuit of the civilian market.

In history's first Presidential Message on Science and Technology to the Congress in 1972, it was acknowledged that an asset unused is an asset wasted. The President stressed the need to apply government-generated technology to solving the nation's social and economic problems and bolstering American leadership in trade competition. This seemed to be the signal for executive agencies to organize and support effective programs for transferring mission-serving technology to wider use in the private sector. A flurry of awareness and organization for technology transfer is now quite apparent in most agencies. Whether or not this effort will be successful in attracting entrepreneurs to government technology remains to be seen.

Scope of Military-Sponsored Technology

Looking back in time, we might ask ourselves why it is that a storehouse of some $200 billion to $300 billion worth of technology, free for the taking, has not been snapped up by private industry. Insofar as defense technology is concerned, the reaction by many to this question might well be, "Who wants to commercialize torpedoes, guided missiles, and tanks?" This is a misconception of the true makeup of technology generated by the military departments. Indeed, weapons and weapon

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systems are the final output of this effort. However, for the most part these systems are made up of components and improvements having other applications. Additionally, research and development to equip and care for military personnel and facilities generates new technology having widespread non-military application. As a result, probably no more than about one out of five inventions in the Navy's portfolio of some 10,000 patents are devices applicable solely to military usage.

Government-financed research and development in furtherance of the Navy's mission has produced technology in such fields as medicine, chemistry, communications, transportation, energy, environmental control, safety, construction and metallurgy, to name a few. Illustrative of recent Navy patents in these fields are inventions entitled: stand-up wheel chair; blood pressure monitor; improved EKG contact; hospital patient monitoring system; measurement of electrical impulses in the eye-brain system for eye examination of very young children; mechanical arm; anti-fouling paint for boats; gasoline additive; underwater adhesive; microphone and headset for underwater swimmers; sailboats; solar panels; oil spill recovery; air pollution control; noise suppressors; trash dump system; waste processing; desalination system; anti-air-collision system; air passenger safety and survival; anti-derailment sensor for trains; firefighting system; etc.

Deterrents to Technology Transfer

Since military sponsorship of research and development does in fact generate technology with potential for civilian use, there must be other reasons why it so seldom makes an appearance on the commercial market. One reason might well be that few entrepreneurs are aware of the military-sponsored technology that is available for non-government use. Over the years, the military departments have not seen it in their mission to imitate the efforts of agencies such as the Department of Agriculture and the National Aeronautics and Space Administration in aggressively publicizing to private industry (and, particularly, small business concerns) what technical innovations are available. In addition, a certain amount of technical information and assistance should normally flow from creator to producer if effective and economical commercial development is to occur. Here again, perspective as to mission, funding, need-to-know, etc., has done little in past years to encourage this ingredient of successful technology transfer.

Thirdly, it must be appreciated that the cost of the research that produces new technology is but a small part of the cost of bringing that technology to the marketplace. Far greater private risk capital is needed at this point than has been expended by the government in its research and development phase. Authorities from the business world estimate that for each dollar spent for inventive activity, $10 is required to develop a working model with commercial appeal, and $100 is needed to tool up, manufacture, promote, and distribute it. If the investment risk of bringing

untried inventions to the commercial marketplace cannot be protected from coattail riding by would-be competitors, the prudent businessman wants no part of the venture. This is especially true in the case of the smaller manufacturer who, having developed and promoted a new item for the market, can subsequently be outproduced and underpriced by a larger competitor with production economies of scale, extensive distribution channels, and no development investment to amortize.

The protection of private risk capital has been ignored in the past by the military departments. Historically, the thousands of inventions in the military patent portfolio (which represent two-thirds of the patents held by the entire Federal Government) have been available only on a royalty-free, non-exclusive basis—essentially public dedication. The poor record of commercialization may be a direct result of this policy and seems to give credence to the adage, "that which is available to everyone is of little value to anyone."

Transfer of technology generated under military research and development programs will not come automatically or even easily. At best, it represents a high-risk, long-lead-time effort for both the agencies and the prospective users. Transfer of technology must take place in military departments that are already faced with increasing mission requirements and decreasing resources, meaning that priorities must be set for funds, manpower and mission objectives. At the same time, the private sector is confronted with the obstacles of inertia, skepticism, and concern over return on investment.

Invention Licensing

In the current effort by the Department of the Navy to carry out the technology transfer mandate, the Naval Material Command is moving forward in a positive manner in the areas of technology analysis, publicity, and technical assistance. In support of the Navy program, the Office of Naval Research, which has Navy-wide responsibility for patent matters, has inaugurated a positive licensing program for its portfolio of patentable technology.

This program began in 1976 when the Secretary of the Navy implemented government-wide licensing regulations issued by the General Services Administration. The basic purpose of the Navy's licensing program is to encourage the earliest possible use of Navy inventions by using the incentives of the patent system. Navy inventions are no longer considered to be in the public domain, nor is a license granted or implied in a Navy invention outside of the framework of Navy licensing regulations.

Navy inventions covered by a U.S. patent or patent application, except those subject to security classification, are made available for licensing by the Office of Naval Research. Lists of available inventions are published in the *Official Gazette* published by the U.S. Patent and Trademark Office, and through the technical

publications of the National Technical Information Service of the Department of Commerce. At this stage, if an applicant is willing to commercialize an available invention on a non-exclusive basis, and shows the intent and capability to do so, the Navy will grant a non-exclusive license, since this leaves the invention available for additional licenses to other interested parties and serves to promote competition in industry. This license is royalty-free and continues for the life of the patent so long as the licensee continues to make the benefits of the invention reasonably accessible to the public.

However, interest by the private sector in technology available only on a non-exclusive basis is limited. Therefore, to obtain commercial utilization of some inventions, it may be necessary to grant an exclusive license for a limited period of time as an incentive for the investment of risk capital. Accordingly, if an invention has been available for licensing for a period of six months with no qualified applicant for non-exclusive licensing, and a prospective entrepreneur is interested only if protected by exclusivity, a limited exclusive license can be negotiated on terms and conditions most favorable to the public interest. Criteria for selecting an exclusive licensee include: his capability to further the technical and market development of the invention; his plan to undertake the development; the projected impact on competition; and, the benefit to the government and the public. An exclusive license gives the licensee the right to practice the invention for a period of time less than the remaining life of the patent. Normally, this would be a period of five to seven years, depending upon the nature of the technology. The idea is to allow one to three years (more in the case of commercialization requiring approval of the Food and Drug Administration or Environmental Protection Agency) for investment of funds and development of the invention for the market, and a period of time at least long enough for the licensee to recoup his costs by exploitation of the invention. In exchange, the exclusive licensee agrees to commit specified resources and effort toward commercializing the invention, and agrees to continue to use his best efforts to practice the invention for the term of the license. Failure to live up to the agreed-upon conditions may be cause for revocation of the license by the Navy.

A royalty provision and/or other consideration flowing to the government is required in exclusive licenses, each case being considered and negotiated on its own merits. In all cases, the commitment of risk capital and the benefit to the public derived from commercial utilization is the prime objective of the transfer of the technology. However, in most instances a fair royalty to the government, payable in some cases after recoupment by the licensee of his investment, is considered appropriate and is normally acceptable to licensees.

A more aggressive promotional and licensing approach to the transfer of Navy technology seems to have produced an encouraging trend of interest by the private sector. Licensing inquiries to the Office of Naval Research jumped from 28 in Fiscal

Year 1975 to 93 in Fiscal Year 1977, an increase of 230 percent. As the result of this interest, the Navy was able last year to get commitments to commercialize 11 inventions on a non-exclusive basis. More importantly, in the first 18 months since inauguration of the Navy's policy of exclusive licensing, seven such licenses have been granted, with proposals to commercially develop five other inventions now in the negotiation stage. This represents spin-off utilization of technology which would not come about without the incentive of patent protection. Also, for the most part, interest seems to center around small business concerns who find exclusive licensing an aid in protecting their entrance into the market and an inducement in obtaining necessary financial backing.

International Technology Transfer

Except for the National Aeronautics and Space Administration and the former Atomic Energy Commission, Federal agencies have generally ignored the foreign commercial potential of their technology, and relatively little foreign patenting has been done by the U.S. Government. As a result, foreign manufacturers have been able to exploit U.S.-patented technology abroad, and American industry has had no patent protection under which to practice government technology outside the United States. Governments of other industrialized countries have been less naive, and traditionally protect significant inventions through use of the U.S. patent system.

To protect U.S. technology abroad, the Naval Material Command, with the assistance of the Navy patent staff of the Office of Naval Research, has added a modest experimental international program to its effort. Two inventions, one in the communications field and the other in the field of industrial temperature control, have been selected and patent applications filed in selected countries in Western Europe and in Japan. A successful international technology transfer program, supported by foreign patent protection, could aid in the protection of Navy technology from exploitation by foreign interests, while leading to a more favorable balance in import-export flow and providing access to potentially useful foreign technology.

Summary

All government bodies are charged with particular missions and responsibilities. Those that provide for the national defense or the improvement of the public welfare seek better devices, systems, and services directly needed to carry out their governmental function. This is accomplished with the improvement and advancement of technology in government laboratories and through contracts for research and development with the private sector. In the national interest, an objective of agencies engaged in research programs must be to encourage widespread use of the improved

technology beyond just governmental use to still broader ends of national policy, including promoting scientific progress, advancing knowledge generally and, above all, encouraging economic growth.

At the present time, the public is being taxed at an annual rate of about $24 billion for government-sponsored research and development. While the major portion of this is directed toward national defense and space accomplishments, the knowledge generated involves all branches of technology and is being largely underutilized.

If the results of this research were channeled to commercialization, in all probability the nation's economy would be enhanced in a great many ways, all of which would benefit the American consumer. As the real purchaser of research, the taxpaying consumer is entitled to additional commercial benefits from his research and development tax dollar.

It is to this end that the Navy's technology transfer effort is directed. It is designed to combine active promotion and cooperative technical assistance with a licensing program using the incentives of the patent system as a catalyst for encouraging the transfer of Navy technology into the stream of domestic and international commerce.

TECHNOLOGY TRANSFER AND PATENT MANAGEMENT AT THE NATIONAL TECHNICAL INFORMATION SERVICE

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Dr. David T. Mowry

The National Technical Information Service (NTIS) traces its origins to President Truman's Executive Order 9604 of August 1945 which established the Publication Board (PB) as a function of the Executive Office of the President to "disseminate scientific, industrial and technological processes and inventions obtained in enemy countries," and Executive Order 9809 of December 1946 which transferred this authority to the Secretary of Commerce where it was located in the Office of Technical Services.

The hastily established teams of civilian technical experts from government and industry followed close on the heels of Army and Navy troops entering Italy, Germany, and Japan, to locate, retrieve, classify, and microfilm truckloads of scientific and technical reports previously unavailable to the business community in the United States. From the outset, then, NTIS has relied on the close cooperation and support of the Department of Defense.

The clearinghouse to catalogue, index, abstract, and distribute these PB reports to American industry was given statutory authority by Public Law 776 in September 1950. The original PB series continues in NTIS as an important collection, now approaching 300,000 reports out of the total holdings of 1.2 million documents.

Today, inflation and unemployment are foremost national concerns, and both are aggravated by dollar devaluation and keen foreign competition. Industrial innovation is needed now more than ever to regain competitive productivity in international trade. Technology transfer into the private sector is required to maximize the benefits of government-funded research and development. This involves much more than releasing reports for distribution.

Definitions of the term "technology transfer" vary widely. Here it is considered to encompass all of the processes by which scientific and engineering knowledge is translated operationally into useful and usable processes that fulfill actual or potential public or private needs. It excludes the communication of research done for an organization for implementation by or for its own purposes. Diffusion or translation into other organizational entities, whether for similar foreseeable uses or unplanned or unforeseen applications, is broadly included.

The recipient of successful technology transfer must, with a minimum of effort, be able to locate, and quickly receive, the specific technology that will fill his needs (or verify its nonexistence). In a tightly programmed development, a report received

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a week after the deadline for a decision or action is almost worthless. To meet this need, NTIS has evolved and grown from the original wartime "library collection" to include all unclassified and declassified government-sponsored science, technology, and business information. Its catalogued holdings have grown to approximately 1.2 million reports available in both paper copy or microfiche, and are increasing at a rate of about 70,000 per year. Over 100,000 titles are in shelf stock, and about 150,000 are of foreign origin. NTIS processes several thousand orders and ships about 20,000 information products daily.

NTIS operates very much as a business, sustained only by its customers. Under its statutory mandate, NTIS must recover all costs of its goods and services. Some 13,000 customers maintain deposit accounts to speed deliveries. Others can use their American Express credit cards. Only about 10 percent of total services flow to other Federal agencies. Unlike the Superintendent of Documents, who maintains about 20,000 current titles, no NTIS title ever goes out of print. Average total sales per document range from zero to tens of thousands, but the average sale is only about 12 copies. It is a unique library which publishes on demand.

Successful, newer NTIS services have provided ways to make it easier for clients to keep abreast of their field or search the collection. Government newsletters in 26 subject areas enable selective scanning, as does SRIM (Selected Research in Microfiche), which provides the entire report for the field-of-interest profile of each subscriber. Abstracts of all documents processed since 1964 are available for on-line computer search and retrieval through the networks of three large commercial firms. Document orders may be placed through the customers' terminals, by 24-hour phone, by Telex, by mail, or in person. Rush handling is available with 24-hour turnaround service, at a small extra fee. Computer searching of the data base is provided to those without access to computer terminals, and over 1,000 prior searches are available in published form.

There are many special cooperative programs with large technical societies, publishers, sources of foreign technical publications, and specialized libraries, which facilitate the identification, reproduction, and delivery of desired technical reports not in the primary NTIS collection. The new NTIS Journal Article Copy service provides fast access to over 6,000 technical journals, with fulfillment provided by about 15 cooperating libraries and information brokers. Publishers receive copyright royalties, and ordering and billing are handled through NTIS computers. Overall sales of information products and services have been doubling every three years.

Patent Management

No attempt will be made here to address in detail the question of overall policy on the ownership of patents resulting from government-funded contract research. A recent report from the Congressional Office of Technology Assessment recommends

a flexible approach to patent management, because Federal support of R&D alone gives no assurance that private sector innovation will result.[1] The 1968 Harbridge House study commissioned by the interagency Committee on Government Patent Policy addressed the question of the effect of such overall patent policy on the commercial utilization of government-sponsored inventions. A good review of this ongoing policy debate was recently prepared by John W. Dempsey.[2]

This discussion will focus on the effort by NTIS to transfer technology to the private sector via licenses under government-owned patents, primarily assigned by employee-inventors. Annually, about 2,000 government-owned patent applications from all agencies are abstracted and announced within a few months of the filing date just like any technical report. There are over 19,000 unexpired government patents listed in the NTIS portfolio to be published soon. A patent, having strict requirements for novelty and utility, should have far greater potential for stimulating industrial innovation than the average technical report, provided that patent management is administered with this objective in mind.

Historically, government agencies have looked on the protection of their inventions purely as a means to prevent the government from having to pay royalties on the fruits of its own research. By establishing priority back to the conception date, it gives safer protection than delaying until a technical publication occurs. The motive has been purely defensive. Reduction to practice has tended to focus on the preferred embodiment of the invention rather than exploring the limits of the technique to obtain broad claims and secure a strong patent which is difficult or expensive to circumvent, and, therefore, valuable to the licensee.

Executive Order in 1950

Statutory authority provided by Congress on patent management for the newer technology-oriented agencies such as the Department of Energy and NASA indicates recognition of the potential for using patent licenses to encourage innovation. Through an Executive Order in 1950, the Secretary of Commerce was given authority to receive custody of the foreign rights to government-owned inventions from other agencies, to obtain foreign patent protection, and to license these inventions. With the large foreign aid programs and favorable foreign trade balances of the 1950s and 1960s, this program was not perceived to have high priority. However, Presidential policy statements issued in 1963 and again in 1971 outlined

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1. Office of Technology Assessment, *Applications of R&D in the Civil Sector: The Opportunity Provided by the Federal Grant and Cooperative Agreement Act of 1977*, GPO 052-003-00545-06 (1978).

2. John W. Dempsey, *The Evolution of U.S. Government Policy Resulting from Federally Funded Research and Development 1941-1977*, Study Project Report, PMC 77-2, Defense Systems Management College, Fort Belvoir, Va. NTIS AD-A052379.

the need for protecting the valuable resource of inventions generated by government funds, and especially the need to acquire foreign patent rights in support of U.S. industry and the government.

In the early 1970s the Committee on Government Patent Policy expressed the need for greater exploitation of government-owned patents to foster the domestic economy, and asked NTIS to be the central point for publishing information on all government-owned inventions. Announcement of patent applications in the *Federal Register* was started in 1972 and in the *Official Gazette* in 1973. The weekly abstract bulletin, *Government Inventions for Licensing*, was launched the same year.

The *1971–72 Combined Annual Report on Government Patent Policy* prepared by the Federal Council for Science and Technology details foreign patent filing results for the decade 1963 to 1972. Of 937 employee inventions in which at least one foreign patent was obtained, 929 were assigned to the Atomic Energy Commission, NASA, and DOD. For contractor inventions where the government had title, the same agencies accounted for 440 out of 444 inventions protected overseas. Virtually no foreign filing was being done by the Departments of Agriculture, Interior, Commerce, HEW, and TVA, whose research, by its nature, should be more easily translatable to private sector needs. As a result, foreign-based companies have been able to utilize the disclosed technology without paying royalties, possibly in competition with domestic firms who were licensed or whose taxes had helped support the invention.

The Committee on Government Patent Policy recommended that NTIS supplement the publication of abstracts and the issuance of a notice of availability for licensing with technical briefs and by direct solicitation. These programs were started in 1976 by the Office of Government Inventions and Patents, established in NTIS the year before. Also in 1976, memoranda of understanding (MOUs) were signed with the Departments of Agriculture, Interior, HEW, and Transportation to transfer to the Secretary of Commerce the foreign rights to inventions considered by NTIS to have commercial and technical potential.

Inventor's Incentive Award

In June of 1977 an inventor's incentive award system was inaugurated under these MOUs, permitting a minor percentage of the annual royalties from licensed inventions to flow back to inventors. Some agencies had permitted foreign patent rights to revert to the inventor, if the government had not exercised its rights within six months of the U.S. filing date. The NTIS program of assuming the costs of promotion, foreign filing and prosecution, licensing negotiations and administration, now becomes an attractive alternative to personal expenditure, which was rarely risked. Employee-inventors in agencies not previously involved in foreign filing are learning that publication prior to U.S. filing is a statutory bar to foreign filing in all

industrially important countries. Instead of filing a quick, defensive patent, more inventors appreciate the royalty potential of a strong, broad patent.

An important result of the analysis by the Committee on Government Patent Policy was the recognition that industry is usually unwilling to license an invention and spend many years and millions of dollars to bring a product or process to the market without the protection of an exclusive license for a limited number of years. Following recommendations of the Patent Management Subcommittee of the Committee on Government Patent Policy, the General Services Administration issued new regulations (41 CFR 101–4–1) in February 1973 for the issuance of limited exclusive licenses. The importance of these regulations cannot be overemphasized, since for the first time the government may provide an incentive to an innovative entrepreneur through a limited exclusive patent license in cases where no company had been previously willing to proceed on a non-exclusive basis.

With new pharmaceutical or agricultural pesticide products, the innovator is faced with 5 to 8 years and tens of millions of dollars of regulatory testing to prove efficacy and safety before sales can begin. He would rather pass up an available free invention than subsidize his competitor. With an important industrial product or process, the only viable alternative to the license incentive is a massive development and demonstration program often costing hundreds of millions of dollars to minimize the risk of private investment. TVA and DOE have used this approach.

The NTIS program encompasses invention evaluation, foreign filing, invention promotion, and use of patent licensing as an incentive to American industry for innovation. From its inception in 1976 and with a small staff, it has built up a modest portfolio of about 70 inventions filed in an average of 5 to 6 foreign countries. In a fourth of the cases, the domestic rights also have been assigned to the Department of Commerce so that a worldwide license can be negotiated.

A number of royalty-bearing licenses have been granted. As with all new programs and with innovation itself, it will be a number of years before a steady flow of new agreements and royalties develops to enable the program to recover its start-up costs. It is anticipated that the program will be self-sustaining in about three years and will thereafter exert a significant effect on innovation domestically, and on economic trade internationally. ‖

27 TECHNOLOGY TRANSFER IN A COMPETITIVE ENVIRONMENT

Charles S. Haughey

During the past 30-odd years, the Department of Defense has developed a remarkably effective and detailed set of regulations, policies, practices, and clauses to deal with intellectual property rights in the development and acquisition of goods and services in a competitive environment. Within existing policies and practices, and in some cases closer adherence to or use of them, major objectives of government and industry can be simultaneously achieved. These objectives might include:

a. Increased incentives for the most qualified companies to seek defense business and to invest their resources to that end;

b. Increased standardization and interoperability within NATO;

c. Improved performance of U.S. industry in securing a favorable balance of trade;

d. Increased profitability of industry; and

e. Increased competition and reduced costs in defense development and acquisition.

A few changes or improvements in present practices could materially contribute to these objectives.

The Present System

Except for the role of patents in a licensing program, this paper will primarily concentrate on trade secret, or technical data, rights as they affect technology transfer. Under its patent rights policy, the Department of Defense does not acquire license rights under "background" patents (those acquired outside of government-sponsored R&D work), leaving such rights to the contractor so that he may be compensated for use of such patented inventions in accordance with statutory policy (28 U.S.C. 1498), and on a par with non-contractor-owned patents. Thus, a patent owner's right to such compensation is not compromised by taking a government contract. Normally, under the DOD "license" policy, patents based on inventions made under DOD-sponsored R&D contracts are licensed free to the government, leaving domestic commercial rights and foreign commercial rights (including foreign government) to the contractor.

The U.S. Government has a statutory license over all U.S. patents under 28 U.S.C. 1498, the Authorization and Consent Statute, and its implementing regulations in DAR (ASPR) 9–102 and the clauses of DAR (ASPR) 7–103.22 and

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7–302.21 by which this license is exercised. Compensation for such licensed use of privately owned patents is provided for in DAR (ASPR) 9–400 administratively, or by suit in the Court of Claims under the statutory authority.

As the U.S. Government turned away from the concept of developing and producing weapons in its own arsenals and began to take advantage of the competition of ideas in the commercial marketplace, it became necessary to accommodate trade secret and patent rights of private parties.

Until about 1965 when Defense Procurement Circular No. 6 was issued, DOD data rights policy provided for the protection of trade secrets and proprietary data by authorizing the withholding of such technical data, while at the same time providing that any technical data actually delivered was subject to any and all rights of use, duplication and disclosure by the government. Drawing the line between the deliverable and withholdable data was often a problem. The Department of Defense also found it had many needs for the proprietary contractor technical data, prompting it to adopt the policy now basic to the DAR that certain categories of data would be submitted with "limited rights" for internal, but government-wide, non-manufacturing use.

This policy generally works well with technical data, but is ill-suited to commercial realities in the computer software field. Accordingly, a policy of "restricted rights" for privately developed computer software was established to appropriately protect such software and to enable use of customary licensing practice of one fee for each computer upon which the software is licensed for use. This is a flexible policy, and it too seems to be working well.

While these data rights policies are fine as far as they go, for proposals to contract with DOD, they are inadequate to encourage submission of those ideas which are not protectable as "limited rights" data, but which, in some cases, are highly valuable concepts and information (other than *technical* information) that should not be released to the public, i.e., competitors. Such proposal data is well covered by provisions of DAR (ASPR) 3–507, and is kept secret unless the owner subsequently furnishes the data under contract (or unless it is released under authority of the Freedom of Information Act, 5 U.S.C. 552).

A major question to be faced is whether the present DOD policies and practices, as written or as actually applied, are adequate in view of current DOD concerns such as: some loss of interest in DOD business, especially at the subcontract levels; inadequate capital investments by contractors to support DOD contracts; increased desires by DOD for licensing U.S. competitors for production; technology transfer within the U.S. industrial base to increase competition and efficiency; and foreign licensing for NATO standardization and interoperability.

Industrial Practices

In the "free," non-government market, technology is rarely "transferred" by industry except for compensation, usually as fees and royalties. Patent and data

rights are customarily employed in a manner appropriate to the needs of the parties concerned and for mutual benefit.

Sometimes a manufacturer will, upon request of a customer, perform R&D at his own expense to supply the customer's need. Sometimes he will perform the R&D as a part of a first-production contract, charging the R&D as part of the cost of the contract. He will usually insist on retaining title to inventions and trade secrets for items in his product line. The customer gains the availability of the item, sometimes with the right, for a royalty, to manufacture it or have it manufactured if production does not fit the developer's plans. Where manufacturing rights are needed, research-oriented organizations are usually utilized, such as universities. In this case, the commercial rights are usually available to the sponsor.

Commercial licensing practices are designed to maximize a profit and to enter markets not easily accessible through direct sales, but are not intended to develop direct competition. With few exceptions, licenses under U.S. patents are readily available, subject to negotiated compensation. Licensing U.S. competitors under specific, detailed designs and know-how is substantially less common unless the owner wishes to dispose of the product line.

In foreign markets, licensing is commonly done in entire product lines with know-how, including detailed drawings, as the main licensed asset, and with patents a secondary, but valuable, part of the license. Royalties are based on the entire licensed technology and are not limited to carefully segregated patented or proprietary details.

It thus follows that technology transfer by U.S. companies to foreign licensees for purposes of NATO standardization and interoperability is a problem very different from technology transfer to U.S. competitors for domestic, competitive use.

Technology Transfer for Domestic Competition

In the formulation of defense programs which require technology transfer, how could the government effectively motivate private industry to continually provide the necessary support, cooperation and intellectual property rights?

a. By avoiding disruption of normal commercial business practices and of existing cooperative relationships between industries in the member nations;

b. By providing the opportunity for fair and reasonable compensation for industrial participation;

c. By enabling the use of industry-owned property rights under conditions that encourage their private development and ownership.

Current DAR (ASPR) practices and regulations could be better used to secure increased competition for U.S. Government business. This is particularly true as to the competition for ideas and new designs, but it also applies to competitive manufacture. Before cooperation of industry can be expected for technology transfer, those contractors having proprietary technology must be assured that it will be

properly protected, reasonably compensated for when licensed, and generally not published or licensed for non-program and non-government use.

The importance of contractor proprietary data is well stated in DAR 9–202.1(b). Nevertheless, there is evidence that DOD buying agencies at the working level frequently seek either *unlimited* data rights or expressions of willingness to license others as part of contract negotiations. This is especially true in studies and early developmental stages where it is impossible to properly price such rights and when, in many cases, the rights are not yet identifiable. Most such studies and exploratory developments are the result of contractor-generated proposals, and are often based on application of contractor-generated proprietary concepts and designs, the probable market for which has not yet been determined.

Providing "limited rights" protection for proprietary data was the intent of the change in data rights policy in 1965. It appears that a stricter adherence to that policy is in order among many buying agencies within the Department of Defense. It must be remembered that *unlimited* rights includes publication rights, which could result in a contractor's trade secrets being transmitted to a competitor. Such information could then be used in *all* lines of commerce, not those limited to the domestic market or to the government. Buying agency personnel should keep in mind that DAR 9–202.2(a) provides that, "It is the policy of the Department of Defense to acquire *only* such technical data rights as are *essential* to meet Government needs" (emphasis added).

Also, according to DAR 9–202.2(d)(1)(b), the predetermination "procedure should apply only to that technical data for which rights may practically be identified....[I]n no case shall the procedure be used to require the Contractor to furnish, with unlimited rights, data which he is entitled to furnish with limited rights under the policy in c [9–202.2(c)] above."

It is difficult to reconcile these policies with the practice of proposing as a contract clause that (a) "all technical data shall be delivered with unlimited rights," or (b) "all technical data shall be furnished without the limited rights legend." The ill will between the contractor and the government that is engendered by this practice could be avoided by strict adherence to the established policies.

The essential need of the government for competitive production rights in contractor proprietary data is provided for in DAR 9–202.2(f), Specific Acquisition of Unlimited Rights in Technical Data, except that it appears that if limited rights are not sufficient, unlimited rights shall be procured. This is often not necessary where an additional license is available for use of proprietary "limited rights" data. This provision does, however, define the government's need for acquiring unlimited rights in terms of four required findings, on a documented record, some of which usually cannot be made at the outset of a study or early development program. For example, "(i) there is a clear need for reprocurement of the item, component or

process to which the technical data pertains"; and "(iv) anticipated net savings in reprocurements will exceed the acquisition costs of the technical data and rights therein." When these findings cannot be made, there is no "essential need" for unlimited rights in a contractor's proprietary data, and limited rights should be routinely accepted. Additionally, when the government takes a license for competitive manufacture by or for the U.S., the license should allow compensation, under the "Entire Market Value" rule,* for the entire device procured, and not merely for proprietary or patented components.

With respect to domestic competition, another refinement of the DAR (ASPR) would facilitate and encourage best efforts by contractors without detriment to the government, and would avoid technical leveling. When DOD finances competitive efforts leading to a "fly-off" and selection of the winning contractor, the competing designs, which may not be proprietary if subject to unlimited rights, should not be interchanged prior to source selection. A procedure should be adopted which would protect such competitive designs during the competition. Such a procedure has already been used successfully in several procurements.

Another problem that inhibits contractors is the use of study contracts to prepare major designs, in which the contract report becomes a proposal for follow-on effort. To avoid unfair exposure of ideas to competitors before award of the follow-on contract, especially in competitive studies, such proposals should be subject to the protection of DAR 3–507.1, the authorized protection for proposals, until award of the follow-on or production contract to the contractor.

Technology Transfer for NATO Standardization and Interoperability

A company contemplating licensing foreign manufacturers must consider several questions. Among them: What are the intellectual property rights pertinent to the national program in which the company desires to participate? Should the agreement allow the foreign licensee to sub-license those rights to industries of other nations? If so, should the licensor provide technical support to the sub-licenses? The factors which must be considered before these questions can be answered include:

a. Whether the selection of sub-licensees would be with licensor's approval;

b. Whether the prospective licensor has sufficient knowledge of proposed cooperative programs so as to enable an intelligent evaluation of the business potential of the pertinent technology;

c. Whether the sub-licensing would provide the private concern a fair return under the circumstances;

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*See discussion and cases in PTCJ No. 339 (Aug. 4, 1977), pp. A-5, 6 and 7, and *Tektronic, Inc. v. United States, et al,* 557 F. 2nd 265, 193 USPQ 385.

d. Whether the technical assistance the licensor or the government would commit the licensor to perform could be properly planned for and budgeted, and whether it would be excused if the domestic program is lost or completed;

e. Whether the potential benefits of participating in a foreign program would offset the potential adverse affects which could result from participating in a NATO program requiring the granting of sub-licenses to existing and potential business competitors.

U.S. industry has traditionally relied on the results of its own R&D, both independent and government-sponsored, to secure foreign military business. A policy of demanding, as a condition of contract award, a license in the U.S. Government for foreign production in any NATO country by any NATO manufacturer can have a destructive influence on the international competitive posture of U.S. business. It could encourage contractors to avoid use of key designs or products in military products, resulting in the loss of foreign licensees, and/or the loss of business to foreign competition. On the other hand, a policy of relying on U.S. and foreign industry to establish their own licensing and production arrangements for standardization and interoperability, under government guidance and with normal licensing incentives, would strengthen existing licensing relationships and establish new ones. It would also improve industry profitability on successful independent research and development (IR&D), extend effective markets, and open doors for cross licensing to U.S. of foreign developments.

Cooperative NATO Development Programs

Let's look at the conditions under which a private concern might consider it prudent to disclose to foreign governments and industries the technical and R&D information necessary to facilitate the formulation of a cooperative development program.

a. The technical information generated during performance of the government contract, as well as information concerning R&D activities which are government-funded, is disclosed pursuant to governmental regulations which allow recovery to the U.S. of compensation for such information.

b. The disclosure of technical information resulting from IR&D efforts, whether already existing as "background rights" or developed in the future as "foreground rights," is limited to that which would normally be disclosed to a prospective licensee for evaluation for potential applicability and use, and is protected accordingly.

c. The disclosure of IR&D activities is program-related, meaning it includes general information concerning objectives, feasibility, and progress, but excludes information the company desires to withhold from competitors.

While we normally think in terms of prime system developers when considering technology transfer, oftentimes a substantial amount of commercially valuable

technology is involved at the sub-contract level. The policies and practices adopted must account for these commercial interests.

Certain key incentives could go far toward encouraging the international technology transfer necessary for NATO standardization and interoperability without disrupting the buy-at-home practices of many NATO members.

For example:

1. Allow retention, for NATO licensing purposes, of foreign rights in technical data as well as patents from U.S. Government-sponsored R&D.

Practices of most NATO governments are documented in a January 1978 report of the NATO Group on Intellectual Property (AC/94). Except for the U.S., most NATO governments allow contractors to retain commercial and foreign rights to foreground data as well as background data. The U.S. practice of acquiring unlimited rights in such data puts U.S. industry at a disadvantage.

For this purpose, a new category of data rights, "Controlled Data Rights," should be considered for inclusion in the DAR. This would be unlimited for U.S. use, but restricted as to foreign use, and publication abroad would be restricted. This would provide a mechanism for foreign licensing of foreground data rights.

2. Avoid exchanging detailed information with European counterparts in the R&D stages—this should be done only after having made arrangements for compensation.

3. Allow private U.S. firms to negotiate licenses directly with licensees of their own choice, subject to government approval.

This would allow more reasonable terms, consonant with the values licensed, to be secured. Also, by choosing its own licensee, a contractor can utilize existing relationships and avoid establishing competitors to his existing licensees.

4. Allow major system subcontractors to negotiate their counterpart licenses either through the prime system licensor, or directly, coordinating with the prime system licensor.

This carries the same benefits as the prior proposal, and may avoid mixing "strange bedfellows" who won't perform well together. Guidance and approval of the government is, of course, provided through the prime contractor licensor.

5. Allow customary licensing practices, including initial disclosure fees; reasonable royalties; full-system royalty base; payment for other use of the licensed technology; and full protection of proprietary data. There should be no attempt by governments to prevent reasonable compensation and licensing arrangements for NATO rationalization, standardization, and interoperability (RSI). Contractors who are not allowed reasonable compensation in their foreign markets become reluctant contractors.

6. Keep the domestic and the foreign licensing needs and licenses separate in order to avoid the "adversary relationship" between U.S. contractors and DOD in

NATO RSI licensing. The needs of the U.S. for competitive domestic manufacture are independent of and very different from needs for NATO RSI. Contractors will often give special considerations to the U.S. Government. Of course, the limiting effects of the Authorization and Consent Statute, which compensates for use of the patent invention but not for the loss of exclusivity and the leverage to other business which it may bring, must also be noted. These considerations, and the "adversary relationship" noted in the Final Report dated 10 February 1978 of the DOD Investment Policy Study Group, should be divorced from the role of assisting U.S. industry in arranging licensed foreign production or co-production of military equipment.

7. Compose a list of candidate products (with schedules and budgets) for NATO RSI, and let companies work their own arrangements for licensing, co-production, etc., subject to final government approval. The industry-to-industry interface has worked well in foreign licensing, and has, in fact, been responsible for some of the existing standardization within NATO. An extension of this procedure would be easy to implement and would be a most effective use of the licensing technique. In this connection, representation of European NATO countries in intellectual property and procurement planning is often by manufacturers, who may be state agencies. Without similar U.S. representation, U.S. industry would be at a distinct disadvantage in this process, and transfer of our technology could be inhibited either by political considerations or by failure to interject the U.S. industry viewpoint.

Conclusion

Technology transfer, for domestic or foreign purposes, must be keyed to the interests of domestic industry. The basic industrial property rights system of the DAR is well adapted to the needs of industry and the government, and merits proper application and the continued support of both government and industry. ‖

35 LIMITATIONS ON THE RIGHT TO TRANSFER TECHNOLOGY

Lieutenant Colonel H. M. Hougen

The Department of Defense is a repository for vast amounts of technical information which is useful and necessary to the manufacture and use of defense equipment. This technology may have been generated during research and development activity or have resulted as a by-product of manufacture. It may have been created by a government employee or a private contractor. It may have been received from another government as part of a cooperative development program or have been submitted by a private company trying to interest the department in buying a product.

This technology is potentially very valuable, but in order for it to be exploited, it must be transferred outside the government. It may be furnished to prospective bidders or contractors to enable manufacture and acquisition of materiel. It may be provided to foreign governments to permit interoperability of equipment or as part of a cooperative program. It may be requested by a private citizen under the Freedom of Information Act. The Department of Defense and its agencies are constantly faced with situations involving potential transfer of technology.

In the course of planning for transfer of technology by the government, it is common to consider policy aspects. Should the technology be transferred? If so, to whom and on what terms? A basic question which should be asked in the initial stages is: Does the government have the right to transfer the technology? This paper discusses some important limitations on the right to transfer technology which may have an impact on technology transfer decisions.

Nature of the Limitations

The most common limitations on government technology transfer are those imposed by property law concepts or contract provisions, where the government does not own the right to make the transfer. This may require cooperative transfer effort between the government and the private owner. A second limitation, though less of a problem for the government agency than for private industry, is the statutory licensing requirement for export of technology. A third limitation is that imposed by international agreements.

Failure to consider these potential limitations will result in problems. Disregard of privately owned property rights or breach of contract provisions will subject the government to liability for damages, either through administrative claims action or through court suit. Attempts to export technical data without necessary licenses will

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result in embarrassment if another government agency refuses to allow the exportation. Violation of a promise to another country to protect information against transfer would strain the international ties that the cooperative effort was designed to strengthen. An important point to remember is that the mere possession of technology is no assurance that the agency has the right to transfer it.

Proprietary Rights

The intellectual property rights affecting technology transfer can include patents, trade secrets, technical data, computer software, and copyrights. The various property rights which control the use of technology can be bought and sold, just like rights in other property. One distinction between technology rights and other forms of property is that ownership of various portions of the rights to use, sell, or transfer the technology property is commonly divided among several parties. The government may own the right to use particular technology for its own purposes, including the right to transfer that technology to a contractor for use in the manufacture of materiel for the government. Another party may own the right to transfer the technology to private companies in the United States. A third party may own the right to transfer the technology to private companies in a foreign country, subject to the government's right to transfer the technology to the government in the same country as part of a foreign aid program. This splintering of rights in the property can cause problems unless the agency preparing for transfer is aware of the existence and the extent of all existing limitations.

Technology can include physical objects, such as drawings or technical data, that are readily severable from the right or ability to use the technology. Contrary to the adage that one cannot have his cake and eat it too, technology *can* be transferred without losing possession of any material objects which represent it. For example, a piece of military hardware is listed on an inventory and kept in a storeroom until issued to a user. When issued, everyone is aware of the change of custody and of the transferred ability to use the equipment. A technical drawing, on the other hand, can be photocopied or visually inspected and memorized, leaving the original document intact and in place. The memory of the drawing or the photocopy can enable another to use the technology which the drawing represents. Neither the owner of the original drawing nor the subsequent recipient of the copy may be aware of the rights or capabilities that may exist in other parties. Unfortunately, it is all too easy to transfer technology without being aware of the fact that a transfer has been made. This can trap the unwary into exceeding the government's authority over an item of technology.

Trade Secret Protection

"Technical data" is a broad term used to describe the information necessary to make possible the manufacture and use of materiel. It includes manufacturing

drawings, specifications, manuals, instructions, and other documentary forms of know-how necessary to convert an idea into a finished product. A complete technical data package enables the holder to manufacture an end-item, although implementing technical assistance might be required. The assembly and transfer of a complete data package is a complicated matter, usually so complex as to call the parties' attention to the need for a licensing agreement or other document. Nevertheless, portions of technical data can be transferred in more subtle ways. For example, when data is used to formulate contract specifications as part of the acquisition process, some technology is transferred to the person reading the specifications.

The creator of a product or system has a large investment in the data package, including the costs of basic research, engineering development, preparation of drawings, pilot programs, and a share of plant overhead. In order to protect this investment, the developer maintains his technical data as a trade secret, hoping to amortize the cost of development over the production life of the product.

It is only by keeping the information out of the hands of competitors that the owner has any protection for the trade secret. If a third party acquires the information, he can use it to make a competing product. If such disclosure is made unlawfully, the owner of the trade secret may take action against the agency that failed to properly protect the data.

If he so desires, the owner of technical data may license to others the right to use the secret information, thereby recovering his costs and making a profit. In order to protect this data from further disclosure, the owner may restrict the licensee from making such further disclosure of the information or from using the data in ways that would unnecessarily risk improper disclosure. From business practices associated with this licensing activity have come restrictive legends.

Restrictive Legends

The simplest and most obvious restrictive legend is that placed directly on an item, clearly advising the holder that the owner of the property right relating to the item is asserting that right and is restricting the use and further dissemination of the item. Ideally, that legend should spell out the specific use which can be made of the item. Frequently, the terms of restriction are so detailed or the nature of the document is such that a clear explanation cannot be placed on the item. The legend then should contain a cross-reference to another source of information about the extent of the restriction.

Technical Data

As explained earlier, the term "technical data" is defined broadly to include all recorded information of a scientific or technical nature. Although computer software is in fact one kind of technical data, it is given special treatment and excluded from the DOD contract clause definition of technical data.

When technical data is delivered under a DOD contract, a data rights clause is included in the contract. Usually, the basic data clause of Defense Acquisition Regulation (DAR) 7–104.9(a) is incorporated into the contract. Under this clause, the government does not necessarily acquire unlimited rights to use or transfer all items of technical data delivered under the contract. Some items previously developed by the contractor at private expense will be delivered with *limited rights.*

Without the owner's written permission, material provided to the government with limited rights cannot be transferred outside the government except for certain purposes. In order to warn government personnel of the existence and extent of the restriction, the basic data clause requires that such technical data bear a limited-rights legend identifying that portion of the document subject to a limited-rights restriction, referring to the contract under which the limitation is claimed, and spelling out the limitation in specific terms.

The contractor bears the burden of marking documents properly with a restricted-rights legend. If he fails to mark the material or to make a timely correction of the failure, he cannot complain later when the technical data from which the legend has been omitted is transferred in good faith to another. The reason for this is clear. The government employee in possession of the document should not be required to inquire into the possibility of proprietary rights on every element of technical data under his control. Because the contractor has the greatest interest in protecting the secret, he also has the duty to assure such protection.

It is, of course, incumbent upon DOD contract administration personnel to ascertain that the contractor does not mark documents with a legend more restrictive than that authorized under the contract, or place a restrictive legend on portions of technical data which the government is entitled to receive with unlimited rights. While improper markings would not give the contractor a greater right to prevent transfer of the information, such markings could thwart proper transfer at a later date. Just as the proper restrictive legend serves to relieve government personnel of the need to search for possible restrictions, so government personnel subsequently handling the documents should be able to rely on the language of the legend and comply with its terms without having to determine if the legend is accurate.

Proper legends give clear guidance about the limitations on release of technical data, thereby easing the job of planning technology transfer.

Computer Software

The basic data clause also provides for restrictions on the rights acquired in computer software. Software prepared specifically under a government contract is acquired with unrestricted rights. Some software prepared previously by the contractor is obtained with the agreement that only *restricted rights* are acquired. The

restrictive legend on restricted-rights software does not specify the extent of the restriction as does the technical data legend. Instead, the legend will refer to the contract, which will in turn contain a specific agreement concerning the extent of the government's rights in the software.

This means that the software legend is not so easy a reference as the technical data legend because of the need to refer to the particular contract. The government employee having custody of restricted-rights software is alerted to the existence of the limitation, but not advised about specific terms until further investigation is made in the contracting office. While it is fairly safe to assume that software subject to a restricted-rights legend cannot be transferred outside the government, the actual documentation should be inspected before a final determination is made.

Patents

The owner of a patent can prevent unauthorized persons from making, using, or selling the patented invention. The limits of the invention are carefully spelled out as claims in the patent certificate, so it is easy to determine whether a given product or process involves practice of the patent. If the party practicing the invention does not have a license from the owner, the patent has been infringed, and the owner has a statutory right to halt the infringement.

When the inventor, including a government employee, is employed to make an invention, the employer is normally the named assignee on the patent certificate. If the government acquires title to an invention made under a contract, it will be named as the assignee. When the government is entitled to a patent license under a contract, the patent certificate will normally mention the license and the contract under which the license was obtained. Subsequent assignments of patents are normally recorded in the Patent and Trademark Office. In addition, an executive order requires the Patent and Trademark Office to maintain a central register of patent licenses and assignments to the government.

When the government owns the patent, the technology which the patent represents is normally transferred by the grant of a non-exclusive, royalty-free license to practice the invention. These are readily granted by the designee of the department head, with a minimum of formality. The government can also grant exclusive licenses under patents which it owns.*

If a government employee or contractor owns the patent, the government has a license only to practice the invention, except that the government's license allows it to transfer the technology to others in order to make possible the manufacture of the item or the practice of the process on behalf of the government.

**Editor's Note:* For a more detailed discussion of the government's use of exclusive licensing, see William O. Quesenberry, "Patents and Technology Transfer," in this issue.

In such case, the recipient of the technology cannot practice the invention for any other purpose. When patent rights are necessary to facilitate the transfer, the parties must obtain a license from the patent owner. This allows the contractor or employee-inventor to bargain for a satisfactory price.

This limitation does not interfere with distribution of the patent document or certificate itself. Patent documents are intended to be available to the public. This illustrates the great difference between a patent and a trade secret. A trade secret can be properly used by anyone having rightful possession of the information, while the patent can be practiced lawfully only with the owner's permission, regardless of possession of information about the patent.

A patent is strictly territorial in nature, having effect in only those countries in which a patent has been issued. If no patent was issued in a particular country, the invention may be freely practiced in that country without permission from any patent owner, although goods incorporating such an invention cannot be imported into a country where there is a valid patent.

The government owns foreign patent rights in very few inventions. Because the cost of obtaining foreign patent protection for the government cannot normally be justified, foreign rights are either abandoned or are left with the employee-inventor or the contractor, who may pursue a foreign patent if he so desires. If foreign protection has been obtained, a license from the owner would be required to authorize practice of the invention in that country.

Copyrights

The owner of a copyright has the sole power to authorize the making, distribution, or public display of copies of a copyrighted work or the making of derivative works such as annotated versions or revisions. The purchaser of a lawfully made copy of a copyrighted work can transfer the original purchased item to a third party without restriction. The purchaser cannot, however, make a copy to transfer or make a copy to keep while transferring the original. Strictly speaking, the ability to lawfully transfer the original document would permit transfer of the technology which the copy of the work represents. However, it is not in the nature of a government agency to give up its sole copy of information. Because the copyright owner can prevent the second copy from being made or distributed, the owner's rights interfere with the transfer of copyrighted technology.

Copyright protection can extend to any document used to transfer technology, including forms like magnetic tape and microfilm that are readable only by machine. Examples of protectable works include manuals, reports, computer software, drawings, models, and audiovisual works. The exception to this scope of protection is a work produced as part of the official duties of a government employee, which cannot receive copyright protection.

The rights of the copyright owner do not extend to protection for the underlying idea; they only protect the embodiment of the idea. Thus, if a copyrighted manufacturing drawing indicates that certain surfaces of a component are to be machined by a particular method and to certain dimensions, the copyright owner has no proprietary right in the making of the component by that method or to those dimensions. The copyright owner's sole right is to prevent the use of unlawfully made copies of the drawing to convey the information. The information can be conveyed by an independently made drawing or in another form, provided the original work is not copied or used to make a derivative work.

Prior to 1978, an author could obtain a statutory copyright only by publishing the work with a formal copyright notice. That notice includes the word "copyright" or the familiar symbol ©, the name of the owner, and the year of first publication. The lack of a copyright notice on a published work indicated that there was no copyright in the work. If unmarked material in the hands of the government had already been published with the author's permission, the government could safely treat the unmarked material as being uncopyrighted. Conversely, the presence of a copyright notice indicated that the work had been published and was therefore not a secret.

The copyright law was changed, as of 1 January 1978. The revision eliminated publication as a step in obtaining copyright protection and made the existence or absence of a copyright notice less important. It is no longer possible to look at a document and determine from the absence of a notice that no copyright exists. This uncertainty is softened by the fact that innocent infringement in reliance on an unmarked copy precludes liability for the infringement.

The current basic data clause for DOD contracts provides that the government can treat software bearing a copyright notice as a published document. This dispels the trade secret protection. When the new copyright law changed the effect of the copyright notice, the statutory basis for the current contract clause treatment was eliminated. Efforts are being taken to change the contract clause to bring it into line with the new law.

The basic data clause also provides a copyright license permitting the government to reproduce and distribute copies of all copyrighted material furnished under the contract, except computer software documentation. Under the old law, when material had to be published before it achieved copyright status, this treatment did not harm the contractor, because it affected only published, non-secret material. Under the new law, all data furnished under the contract is in fact protected by copyright unless there is a specific provision to the contrary. Literally, this permits the government to distribute publicly copies of material which describes the technology to which it has obtained only limited rights, despite contract language prohibiting general distribution of the information. This discrepancy is also being corrected by proposed revision of the contract clause.

Assuming that current contract provisions are corrected in the near future, how will copyrights affect transfer of technology obtained under a contract? The copyright license contained in the contract will be compatible with the quantum of rights in data provided under the contract. If the material has been obtained with unlimited rights, the copyright will not interfere with unlimited-rights use. If the material has been obtained with limited or restricted rights, the copyright license will permit use coextensive with those rights.

One exception to this simple treatment of copyrighted material involves material furnished under a contract without a license. If the contractor has obtained written permission from the contracting officer, delivered material can incorporate unlicensed copyrighted material owned by another. If such material is provided, it should be properly identified to prevent accidental infringement of the copyright.

Copyrighted material obtained under one of the other data rights clauses will be accompanied by a license sufficient to permit technology transfer. If copyrighted material comes from a source other than normal acquisition activity and therefore without data rights clauses, the copyright must be respected. Unless permission is obtained from the owner, copyrighted material from non-contractual sources should not be copied for distribution, and copies should not be transferred to another party. When the work has been published and is otherwise available, the transferee of related technology should be referred to an alternate source for that portion of the information.

Data in Unsolicited Proposals

Material which has been submitted in an unsolicited proposal is entitled to both copyright and trade secret protection. The owner has an obligation to mark with a restrictive legend the proprietary information submitted in an unsolicited proposal. A restrictive cover sheet is also attached upon receipt. Material thus received cannot be transferred outside the government without express permission from the owner and should be protected accordingly.

Statutory Export Controls

The Arms Export Control Act gives the Department of State authority to control the export of technical data pertaining to defense items listed by category on the United States Munitions List. The International Traffic in Arms Regulations (ITAR) establish licensing procedures for the export of such technical data. The Export Administration Act gives the Department of Commerce authority to control the export of technical data other than that covered by the ITAR.

Exports by government agencies are excluded from the license requirements of these statutes, but that exclusion does not apply to exports by private companies. Thus, if a three-way technology transfer program requires transfer by the private

owner to a foreign transferee, an export license would be required. It would be appropriate for the government agency involved in the arrangement to agree to provide its best efforts to facilitate the issuance of the license. The agency could not guarantee a license because the final decision would lie with other departments.

International Agreements

Under provisions of international agreements, the government may be committed either to refraining from transfer of technology or to obtaining concurrence of another government prior to transfer. One example of such a commitment is the Nuclear Nonproliferation Treaty, in which the several parties agreed to refrain from transferring technology which could create new nuclear powers. This obviously limits transfer of nuclear technology to countries not previously having a nuclear capability. Another example is a memorandum of understanding (MOU) for cooperative research and development, either for a particular program or for general applicability. Such an MOU would normally require consent of the parties before technology developed under the program could be transferred to third countries.

Another type of information which is not readily transferable is that received from foreign sources with the understanding that it is proprietary and not transferable. Such information can be received under agreements like the NATO Agreement on the Communication of Technical Information for Defence Purposes. That agreement requires that the proprietary information be marked with a restrictive legend to provide a warning of the existence of the restriction. Under such agreements, it is common for the government to be obligated to compensate the owner for damages resulting from improper disclosure.

The nature of the restriction varies from one agreement to another; therefore, it is necessary to consult the particular agreement prior to transfer of the technology. This presents no problem if the particular item of technology is identified as relating to a particular program or agreement. When the technology relates to an older program, it can be difficult to identify the technology with a particular MOU. It is important for technology created under a cooperative program to be identified with the program for later reference to the controlling MOU. Otherwise, the agreement could be accidentally breached at a later date by improper transfer of the technology.

Summary

Technology transfer planning must recognize potential limitations on the government's right to make the transfer. If the technology is subject to privately owned proprietary rights, export licensing requirements, or restrictive agreements with other governments, the facts should be determined early in order to initiate necessary coordination and licensing activity. Delay in recognizing these limitations can lead to delay or termination of the technology transfer activity. ‖

CONTROLS ON WEST-TO-EAST TECHNOLOGY TRANSFER

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William A. Root

Before beginning our discussion, it is important that we come to some agreement as to the meaning of the key words in the technology transfer area as they will be used here. Although these same terms have been and will be used in different ways in different contexts, for our purposes they may be defined as follows:

Controls are United States export controls administered by the Department of State (munitions), the Department of Energy and the Nuclear Regulatory Commission (nuclear), and the Department of Commerce (industrial items), as well as similar controls administered by other Western governments acting through an organization known as COCOM or Coordinating Committee. COCOM includes all the NATO countries less Iceland, plus Japan.

West refers to COCOM member countries or, in some contexts, member countries of the Organization for Economic Community Development (OECD).

East refers to European Communist countries excluding Yugoslavia or, in some contexts, the U.S.S.R. and its Warsaw Pact allies plus the People's Republic of China (PRC).

Technology refers to goods/products and technical data, the export of which to the East is controlled by the West because of judgments that such items could make significant contributions to Eastern military potential at the expense of Western security.

Transfer includes all means of conveying technology from the West to the East, such as export of a commodity, a license permitting use of know-how, training, cooperative activity, transmittal of information, or consultation.

United States Objectives

The Export Administration Act establishes that it is current U.S. policy "to encourage trade with all countries with whom we have diplomatic or trading relations," as well as "to restrict the export of goods and technology which would make a significant contribution to the military potential of any other nation or nations which would prove detrimental to the national security of the United States."

Thus, the export *restriction* objective is explicitly linked with an export *encouragement* objective. This does not mean that we are to compromise national security. Rather, it means that we are to limit controls to those required for the protection of

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our military security, recognizing that the political, economic, and commercial effects of a liberal trade policy can also make positive contributions to national security as well as to other national interests.

Policy Variations Among Countries

The encouragement objective does not extend to exports from the U.S. to North Korea, Vietnam, Cambodia, or Cuba, against which we maintain what is virtually a total embargo on trade. Nor does the encouragement objective extend to U.S. Government-supported credits and most-favored-nation (MFN) tariff treatment in trade with the East, except for Poland, Romania, and Hungary. This policy is at variance with that of other Western countries. For example, none of our allies embargoes trade with North Korea, Vietnam, Cambodia, or Cuba. Additionally, other Western countries finance exports to the East with massive credits, much of which is government-supported. All other OECD countries grant most-favored-nation treatment to all Communist countries, except Canada to the German Democratic Republic. With respect to the control objective, the U.S. and its COCOM allies all limit strategic exports to the U.S.S.R., its Warsaw Pact allies, and the PRC.

Degree to Which Policy Objectives Have Been Achieved

The U.S. policy to encourage trade with all Communist countries (except North Korea, Vietnam, Cambodia, and Cuba) resulted in the early 1970s in impressive percentage increases in U.S. exports to the East of both agricultural and non-agricultural commodities. However, the U.S. share of Western non-agricultural exports to these countries is still much lower than one would expect, considering the more favorable U.S. trading position in other parts of the world and the presumed general preference of Communist countries for U.S. technology. The Soviet desire for Western technology is restrained not only by foreign exchange limitations, but also by preferences for self-sufficiency and for minimizing the ideological questioning that might result from extensive contacts with foreigners. The U.S. desire to increase these exports is supported by our objectives to reduce our balance of payments deficit, to increase the Soviet sense of independence in the international arena, and to develop contacts which could reduce ideological tensions.

U.S. restrictions on the transfer of strategic technology do not greatly impact on these considerations because, for most advanced strategic technologies, restrictions are warranted by the need to protect proprietary information as well as by security considerations. Furthermore, there is considerable scope for useful contacts between scientists of the two countries in areas of basic research far removed from practical technological applications.

The U.S. share of technology exports to the East, as defined in this paper, has grown somewhat, in that the U.S. now submits a significant share of the cases reviewed by COCOM which are submitted by member governments as proposed exceptions to the embargo. However, COCOM exception-case approvals are less than 1 percent of total exports from West to East. Exports approved by COCOM as exceptions from the embargo have increased in the last 10 years. The value per year of approved exception cases in millions of dollars (at current prices) has been:

1967	11	1973	106
1968	8	1974	119
1969	19	1975	185
1970	62	1976	162
1971	56	1977	214
1972	124		

While this trade has increased substantially in relative terms, the absolute amounts are still very small. To put them in perspective, from 1965 to 1975, total exports from COCOM countries increased from $120 billion to $568 billion, and the share of those exports that fell under exception cases increased from only $4 billion to about $32 billion. The value of COCOM-approved cases is so small that one or two large transactions, reviewed because of the presence of some embargoed components, often skew the data.

Another factor that affects these statistics most significantly is the procedure whereby COCOM reviews a large number of cases involving computers, for which there are many bona-fide civil uses. Computers consistently account for more than half of the total COCOM-approved cases. The United States portion of COCOM cases was very small until the 1970s, but is now running about 40 percent of the total, in large part because of the U.S. leading position in the computer industry.

The U.S. policy to restrict exports for security purposes has probably slowed the rate of transfers of items judged to be strategic. Of course, there has been some circumvention of the embargo, but denial actions and the mere presence of controls have had their effect.

There is some validity to the argument that an embargo is self-defeating to the extent that it encourages indigenous production of embargoed items in targeted countries. But even when this happens, the embargo can slow the process of closing the technological gap, provided it does not engender a sense of complacency in the West, which could discourage new research and development.

Criticisms of Export Controls

Criticisms and recommendations regarding export controls usually include the following: (1) criteria should be more oriented to use-pattern in the East; (2) technical data should be emphasized more than products; (3) U.S. exporters should

not be unfairly penalized because of less rigorous controls in other Western industrialized countries; (4) the government should reach decisions more quickly; and (5) factors other than military should be given greater weight. Let us now deal with each of these in turn.

CONTROL CRITERIA

The three principal criteria used to determine whether an item is strategic and should therefore be subject to controls on exports from West to East are (1) military use in peacetime; (2) militarily significant extractable technology; and (3) militarily significant deficiency in the East. In reviewing a proposed exception from the strategic embargo, the particular circumstances of the case are examined to judge the probability of: (a) diversion of the exported commodity to military use; (b) transfer of the incorporated technology to military use; or (c) alleviating a critical deficiency in the East.

These criteria do not provide unequivocal bases for export control decisions. We simply do not have enough information to apply them completely objectively. In the absence of better information, we usually assume that the East would use an advanced technology for military purposes if we have done so or plan to do so. This assumption may frequently be incorrect. Eastern military systems are generally less technically sophisticated than ours. Furthermore, Eastern ability to absorb and diffuse technology is limited by the rigidities of centrally planned economies. Such thinking would lead to the novel approach of developing criteria aimed at controlling lower level and more easily assimilated technology while permitting the transfer of more advanced technology. This would be intellectually difficult to defend and would also entail considerable risk and administrative complications.

COVERAGE OF TECHNICAL DATA VS. PRODUCTS

There is a growing tendency to place more emphasis on technical data and less on products in controlling exports. Congress is becoming increasingly interested in technology transfer. Amendments to the Export Administration Act call for four reports on technology transfers: (1) multilateral export controls, to include an analysis of exports of advanced technology by countries not participating in COCOM, including such exports by U.S. subsidiaries abroad; (2) changes which should be made in U.S. unilateral and multilateral controls, including controls on technical data to protect U.S. national security; (3) the problem of the export of published technical data; and (4) the impact of technology transfers on jobs at home. The International Security Assistance Act of 1977 calls for a comprehensive study of technology transfers.

A 1976 Defense Science Board report focused attention on the idea that controls should apply principally to critical technologies and to keystone production equipment, with less emphasis on commodities. Extensive efforts have been directed

toward identifying, from a zero base, just what technologies and equipment are critical. This study is not yet complete.

Controls have emphasized technology and production equipment for most of the past 30 years. Present lists include manufacturing equipment judged to be especially useful in the production of embargoed goods. They do not include all equipment used to manufacture embargoed items, because much of that is general purpose machinery. Comprehensive technical data controls are also in place, but they do not identify the especially critical technologies. In spite of this lack of specific coverage, the case load is relatively light. This is apparently because: (1) most companies would rather sell end-items than sell their manufacturing technology, and (2) most transfers of technical data are associated with equipment exports, which are otherwise controlled.

Some approximate statistics indicate the amount of U.S. technology approved for transfer to the East. Commerce issues about 150 licenses a year for export of technical data to Communist countries, most of which are unrelated to strategic items. About 50 of these licenses are for the U.S.S.R. Only about one-third of the licenses issued are followed by actual sales. Given the technological capability of U.S. industry and the Soviet desire for U.S. technology, the flow of licensed technical data to Communist countries is not large, indeed, not much larger than U.S. purchases from the U.S.S.R. of licenses to use their technology here.

The United States imposes no restrictions on the importation of technology from the Socialist economies, other than general tariffs on the import of products incorporating technology. U.S. firms have purchased 26 licenses, at an estimated cost of about $14 million, for the use of Soviet technologies, mostly mining, metallurgy, medical equipment, and pharmaceuticals. This data covers the period since 1964, but most of the activity has been since 1970. This is small compared with U.S. payments of $434 million in license fees and royalties to all foreign companies worldwide in 1975. Nevertheless, there is a growing awareness that the U.S.S.R. has something worthwhile to offer in some fields.

Of course, exports of U.S. technologically advanced *goods* to the U.S.S.R. are considerably higher than the reverse flow. It is thus evident that technology flows from the U.S. to the U.S.S.R. mostly in conjunction with commodities rather than in the form of pure technology.

It is sometimes argued by both business and government that controls on the export of technical data are not very effective; however, the evidence does not seem to support such a conclusion. It is true that information can be transferred in many informal ways that are difficult or impossible to detect. But the most beneficial transfers are those in which the recipient is able to set into production a new facility or manufacturing method, turn-key or otherwise. Such developments do not go unnoticed, and no such comprehensive, systematic transfers from the U.S. to Communist countries have taken place in circumvention of U.S. controls.

There are also COCOM controls on transfer of technical data. In the past 10 years, 74 cases involving technology related to various items have been submitted by other countries to COCOM. Of the 74, 9 failed to receive the required unanimous approval of the Committee, and 6 others were withdrawn. Of those which the Committee approved, provisos were attached to 26 cases to eliminate especially significant technology or to require assurances on civil end-use of the commodity involved.

The Defense Science Board report referred to earlier also stressed the need to control the more effective means of transfer, such as turn-key plants with accompanying training. Existing controls do not differentiate between various means of transfer. It would not be rational to subject an especially critical technology to controls if transferred by one means, but not if transferred by another. However, it is somewhat reassuring that it is more difficult to circumvent controls if the more effective means of transfer are utilized. For instance, highly visible turn-key plants are more effectively controlled than surreptitious, casual conversations.

The scope, function, and instrumentality of a technology transfer are not as significant as the capability of the recipient to make effective use of it (absorption) and the capability of others in the recipient's country also to benefit (diffusion). Most technology is transferred through commercial transactions rather than through either bilateral or multilateral governmentally sponsored programs. The aims of the transfer are important; but these aims may not be realized, or may be realized only inefficiently, if the necessary conditions for effective absorption and diffusion are not present.

DISCRIMINATION AGAINST U.S. EXPORTERS

In most instances where the transfer of technology is controlled, the U.S. does not have a clear superiority *vis-a-vis* other Western countries. The effectiveness of controls therefore depends upon Western cooperation.

It is evident that the U.S. has played the lead role in COCOM since its inception; that other Western countries have consistently pressed for less restrictive controls than the U.S. would accept; and that the U.S. applies more resources to enforcement of controls than do our allies. Nevertheless, COCOM has been reasonably successful in maintaining a system of parallel national export controls.

COCOM was established in 1949 by informal agreement of its members. It is not based on a formal treaty or even an executive agreement. The members have no legal obligation to participate in COCOM or to abide by its recommendations. Yet, in only a few instances has national sovereignty been invoked to approve cases over U.S. objections in COCOM.

Principal COCOM activities are the negotiation of a detailed list of 150 items to be controlled, and the review of proposed specific transactions as exceptions from the embargo.

The list contains highly technical descriptions of commodities, virtually all of which incorporate advanced technology. The list is in three parts: munitions, atomic energy, and industrial. Earlier quantitative and watch lists have been abandoned. Many item definitions contain administrative exception notes permitting shipment at national discretion up to specified technical cut-offs. A major purpose of such notes is to retain the production technology under control.

COCOM actions are based on the rule of unanimity. In practice this means that the U.S. can and often does veto proposals from others to relax the embargo definitions or to make shipments as exceptions. Other members can and do on occasion object to U.S. proposals to strengthen the embargo.

Differences in interpretation of COCOM definitions have occasionally been a problem, as have illegal diversions. But there has been a broad and long-standing acceptance of the security need for controls by governments and exporters in COCOM member countries.

There are strong commercial pressures to sell, and strong skepticism as to the security significance of restricting most potential sales. On the other hand, every COCOM member is convinced that the promotion of trade with the East must be conditioned by the proviso that such trade not include items which would adversely affect Western security. Given the recognition that some controls are necessary, there is a political-economic imperative to coordinate controls with others so as not to deny one's own exporters business which one's neighbor would not prohibit.

Several Western countries do not have legislative authority to control the export of technical data. Legally enforceable controls are more orderly and clear cut. However, the absence of legal authority does not mean the absence of a control capability. The advanced technologies of greatest concern are held by a relatively few companies. These companies wish to cooperate with their governments in the interest of security. Therefore, even in the absence of a legal compulsion, they voluntarily control the transfer of technologies recognized to be of security significance.

In the 1970s, the U.S. has emerged as the leading requestor of exception cases in COCOM in many instances breaking new ground. Looked at broadly, charges that U.S. exporters have been the victim of discrimination do not hold up.

This larger picture does not placate nor should it placate the individual U.S. exporter who has reason to believe that foreign competition is less inhibited by controls. For this reason, the U.S. export control community goes to great lengths to develop U.S. positions on COCOM cases on an equitable basis. Strategic criteria may not be susceptible to strictly objective application, but it is usually possible to act consistently on similar cases. In addition, the U.S. seeks remedial action from other governments when information becomes available suggesting illegal sales.

U.S. businessmen often cite the presence of Western equipment in the East as evidence that the embargo is ineffective. However, such evidence is often misleading.

For instance, some sales are approved because the particular end-uses and end-users are judged to be civil, with little risk of military diversion; whereas other proposed sales of similar equipment are denied because circumstances bearing on the risk of diversion are less reassuring. Furthermore, exhibits of embargoed items at trade fairs in the East are not synonymous with sales to the East. COCOM does not prohibit temporary exports, and some COCOM countries are more liberal than others in permitting demonstration of items which would probably not be approved as COCOM exceptions in the event of sale. Thirdly, during negotiations with Western suppliers, Eastern countries often exaggerate the availability of items from Western competitors as part of their bargaining tactics.

DELAYS

It often takes months or even years for the government to resolve export control cases. It is small consolation to the affected companies that most exports do not require a license and, for those that do, licenses are usually issued expeditiously.

The problem of delays has prompted attempts at legislative remedy and many efforts within the executive branch to improve the situation. Yet, long delays continue to be experienced.

It would be tempting for the administrators of controls to conclude that there must be an inherent reason for delays. Indeed, technical and administrative complexities are formidable. Some of the delays are occasioned by efforts to find conditions permitting an otherwise unapprovable case. But there is still considerable room for improvement within the bureaucracy. Many devices to expedite decision-making are currently being explored, including quite a few which have been studied and perhaps even tried before. But it is apparent that improvement will not come easily.

FACTORS OTHER THAN MILITARY

Some critics maintain that items should come off the control lists because of the positive security effects from political and economic trade benefits. Others maintain that items should be added to the lists because of the importance of the industrial infrastructure to military effectiveness in targeted countries. There is some merit to both points of view.

Foreign policy considerations are often couched in general terms which do not seem relevant to the specifics of individual cases. But general arguments are relevant. Through trade we can reduce, even though we cannot eliminate, the threat of conflict. Trade with the Communist countries broadens the area of mutually beneficial relations. With increased foreign trade, Communist countries must give more than minimal consideration to the impact of foreign policy decisions on their economies. Thus, Western technology adds a measure of restraint on Eastern actions. The question is not whether political considerations should override security considerations—the question is whether the political security benefit from technology transfer is worth the military risk.

During a war situation, a country's entire economy is geared to support the military effort. Accordingly, it was not surprising that U.S. legislation enacted during the Korean war called for restricting the export of items which would contribute to the economic as well as the military potential of another country which would be detrimental to U.S. security. This legislation was amended in 1969 to delete the economic potential criterion.

Given pressure from other COCOM members to relax rather than strenghen present controls, and the ineffectiveness of a unilateral U.S. embargo except for the narrow range of items uniquely available in the U.S., it seems unrealistic to give more than theoretical attention to reverting to the economic potential test.

It is sometimes argued that when the U.S.S.R. imports Western technology for clearly civil purposes, the Soviet military nevertheless benefits because resources otherwise required for indigenous development of the technology could be applied to military purposes.

It appears, however, that on balance, Soviet technology imports for civil purposes have demanded more resources than they have released. As a case in point, Western technology has been imported for the production of automobiles and trucks. This has required allocation of vast amounts of domestic resources not only for the plants for such production, but also for highways and other infrastructure required throughout the country.

Conclusions

Technology transfer controls, while imperfect, have been reasonably effective and should be continued. They do not and should not be expanded to affect a major segment of Western exports, because in addition to strategic export controls, a healthy trade with the East is also in our security interest. It is not feasible to redirect criteria toward less advanced technology used in the East, nor to take into account Eastern problems of absorption and diffusion of technology.

Controls should concentrate on critical technologies and on key items of manufacturing equipment, but this approach is not novel. The desired selectivity in items to be controlled can be achieved only with great effort, taking into account the work of many periodic list reviews over the past three decades which have had this objective.

Cooperation with our allies is essential. In spite of strains, such cooperation continues because of the broad consensus that security export controls are necessary. From a broad perspective, controls have not discriminated against U.S. exporters, but there is a need to be alert to instances where controls could be administered more equitably.

Not all delays in processing cases are caused by bureaucratic inefficiency, but there is room for administrative improvement.

Factors other than military also affect our security, but analyses of possible significant military use should continue to play a major role in export control decisions. ‖

53 THE FEDERAL LABORATORY CONSORTIUM FOR TECHNOLOGY TRANSFER

Robert C. Crawford

Federal laboratories and research centers of the United States have over the years made substantial contributions to the welfare of our country. At the same time, the nature of our institutional system, the complexity of the problems being faced today (many related to the introduction or control of various technologies), and the difficulties inherent in the technology transfer process itself, have made it difficult to derive the maximum benefit from our nation's tremendous store of scientific and technological knowledge. The Federal Laboratory Consortium for Technology Transfer is designed to help deal with these difficulties and to stimulate more effective utilization of available resources.

The science-and-technology system we are describing can be likened to a "three-legged stool," with one leg being the science-and-technology suppliers, the second being the user communities in State and local government and private industry, and the third being the linkage mechanisms which enable the first two pieces of the system to relate effectively to each other. The National Science Foundation (NSF), through its Intergovernmental Program, has been pressing for institutional and process changes in this area since 1967. In the interim, NSF has been responding to initiatives on the part of both State and local governments and the scientific and technological communities, as they move to strengthen their mutual capacities and relationships.

Changes are needed in all three elements if we are to significantly increase the application of laboratory-fostered scientific and technological knowledge to domestic-sector problems. Much has been done along these lines over the past several years. Stronger motivation for servicing domestic-sector needs is being evidenced by scientists and engineers in many institutions. New relationships are being formed every day between knowledge-generators and the policymakers and administrators who are dealing with the issues and problems facing our society. Universities and Federal laboratories and centers, for example, have associated themselves with their State and local governments in projects designed to achieve useful dialogues (e.g., providing backup to technology staffs at the city and county level, and furnishing scientific advisors and other staff support to governors and to State legislatures). In fact, in recent years there have emerged new professions—public policy scientists at the State level, and technology agents in local governments. Interest in joining these new professions is high. This is evidenced in the recruitments for staff scientists by the State legislatures of New York, Pennsylvania, and Minnesota—each resulted in more than 100 applicants.

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A number of the national educational associations, including the National Association of State Universities and Land-Grant Colleges, The American Association of State Colleges and Universities, and the American Society for Engineering Education, have been leaders in exploring ways to ease the flow of scientific and engineering information into the domestic sector. Another segment of the scientific and technological community—the professional societies—has also been engaged in this new thrust. A number of such societies have come together in a consortium designated as AISLE (An Intersociety Liaison Committee on Energy and the Environment). This consortium, with the support of the American Association for the Advancement of Science, is designed to increase the knowledge flow from members of the societies to officials in State and local governments.

Over the past decade, similar movement has occurred in the user community. State and local governments have begun to develop a new and stronger motivation to seek information from the scientific and technological community. This, to some extent at least, is a result of the increased number of policy and operating issues with significant scientific and technological implications. In addition, there is the need to deal with complex problems in the face of often severely constrained resources. For instance, the passage of Proposition 13 in California and its possible adaptation elsewhere will, no doubt, spur the search for productivity increases in government. Such increases can be made possible by the introduction of new technologies and innovative approaches.

Already, with partial financial support from the National Science Foundation, the Departments of Transportation (DOT) and Housing and Urban Development (HUD), and the Fire Control and Protection Administration (FCPA), the 28 largest cities in the U.S., and 8 large urban counties have joined in the Urban Consortium for Technology Initiatives. This consortium is providing, for the first time, a unified statement of needs for consideration in developing the Federal Government's R&D agenda. It is designed, also, to permit participation by these large jurisdictions in the planning and performance of high-priority research and to facilitate their participation in demonstrations and replications.

NSF has responded, as well, to the initiatives of local governments in population ranges up to 500,000. This is shown by the provision of partial support for the Urban Technology System (UTS) and the Community Technology Initiatives Program (CTIP), respectively. Each of these "innovation networks" is composed of about 30 representative cities and counties. Public Technology, Inc., a non-profit organization established by the national public interest groups representing State and local governments, provides the secretariat for these national networks. In addition, a number of regional innovation networks are developing across the country. These are being linked to the national networks to stimulate the use of information from the scientific and technical community and innovations proven successful in other jurisdictions.

In State government, much has been happening. Both the executive and legislative branches, on their own, and with "seed-money" support from the Intergovernmental Programs of the National Science Foundation, have been experimenting with new approaches to strengthening their capabilities in science and technology. They have also been increasing their linkages to the resources available in universities, Federal centers and laboratories, non-profit research institutions, industry, etc. Last year, the Congress, feeling that high national potential had been demonstrated in this area, added a $3 million authorization for the National Science Foundation to conduct the State Science, Engineering, and Technology (SSET) Program. This program offered planning grants of up to $25,000, with a State match of $12,500, to each State executive or legislative branch for the purpose of analyzing the State's needs for S&T input, the resources available, and the means for maximizing S&T contributions to the State's policy process. Forty-nine executive branches and forty-two legislative branches have received awards under this program. The administration of this planning program has been greatly aided by the National Governors' Association and the National Conference of State Legislatures.

The significant developments in intergovernmental science relations over the past 7 or 8 years, some of which were mentioned above, can be tied to some extent to a series of analyses and policy statements identifying potential for significant national benefit in this area.

In 1972, a Presidential Message on Science and Technology was presented to the Congress. This message called for increased cooperation between our science and technology resource institutions, our Federal, State, and local governments, and the private sector in the matter of applying new knowledge in domestic matters. In addition, two studies, *Public Technology—A Tool for Solving National Problems* (1972), by the Federal Council on Science and Technology's (FCST) Committee on Intergovernmental Science Relations, and *Power to the States—Mobilizing Public Technology* (1972), by the Council of State Governments (CSG), and a national conference in 1972, which resulted in a report entitled *Action Now*, provided a national focus to the issue. These reports made recommendations for improving the flow of domestic-sector needs into research planning and the dissemination of new knowledge to State and local officials. The reports presented suggestions for policy initiatives, programs, research, development, and demonstration projects.

The FCST Report recommended that Federal laboratories be made available for use by States and localities. The CSG Report recommended that the laboratories be authorized to provide technical information and project management assistance. *Action Now* stated the same position as the CSG Report and went further to indicate that the laboratories should be designated to serve States and localities as backup organizations. It also indicated that: (1) R&D results from the laboratories should be assessed for applicability to State and local needs; (2) Federal funding should be

made available for adaptive engineering, demonstration projects, and the like; and (3) necessary laboratory manpower should be made available for these activities.

Also, with particular regard to the laboratories, the Presidential message referred to above called for finding ways to assure that State and local governments have access to the technical resources of major Federal R&D centers.

Three additional reports are noteworthy in considering the role of Federal laboratories and centers in this area. Both the Committee on Federal Laboratories of the FCST in 1974, and the CSG in 1973, prepared special reports on intergovernmental uses of Federal R&D centers and laboratories. The reports recommended that (to quote the FCST Report):

> ...consistent with existing laws and established relationships with private industry, universities and non-profit institutions, existing research and development capabilities in Federal establishments be utilized effectively to define and solve technological problems and guide the technical content of policy decisions relative to such urgent national needs as the environment, transportation and health.

A General Accounting Office Report issued in December of 1972 recommended the development of a government-wide policy for technology transfer, the establishment of procedures by the Secretary of Defense for more extensive application of existing defense technology to civilian problems, and the establishment of a technology transfer consulting team to help Federal agencies match resources with needs.

More recently, the Congress enacted the National Science and Technology Policy, Organization and Priorities Act of 1976 which states:

> ...The Federal Government should support and utilize engineering disciplines and make maximum use of the engineering community [and] advise and assist the Director in identifying and fostering policies to facilitate the transfer and utilization of research and development results so as to maximize their application to civilian needs....

Another provision of this act that is of considerable significance to technology transfer to State and local government is the establishment of the Intergovernmental Science, Engineering, and Technology Advisory Panel (ISETAP). This panel is chaired by the President's Science Advisor and is composed of governors, State legislators, regional and local officials, and the director of the National Science Foundation. The panel is intended to identify and define civilian problems at State, regional, and local levels which science and technology inputs can help solve; to establish priorities for addressing the problems; and to identify and encourage ways to facilitate the transfer and utilization of the results of Federal research and development activities to maximize their application to civilian needs. This panel has been extremely active in moving to exercise its responsibilities, with effective staff

support from the Office of Science and Technology Policy. It has organized itself into five task forces which have been engaged in discussions with a number of Federal agencies regarding their R&D programs. It has also performed special analyses in such areas as State and local use of satellite-provided information. Quite recently, ISETAP completed an extensive collection and categorization of problems which State and local governments believe important and which have scientific and technological components. The second phase of this process is now underway. It consists of a series of meetings involving researchers and State and local users intended to identify, more specifically, the researchable components in selected problems. This activity is being managed by the American Association for the Advancement of Science under a grant from the National Science Foundation.

The preceding survey gives some indication of the setting which was emerging when the Federal Laboratory Consortium for Technology Transfer was established, and provides some background for subsequent developments that have impacted upon the consortium's evolution during the past 7 years.

The Consortium

The Federal Laboratory Consortium for Technology Transfer is an informal grouping of Federal laboratories and R&D centers joined together to facilitate the systematic use of their resources in dealing with domestic-sector problems. Starting in 1971 with a small group of 11 facilities (all from DOD, predominantly Navy), designated as the DOD Consortium, the consortium membership has grown to 183 laboratories and centers of all sizes, representing 10 Federal agencies. These include DOD, Commerce, Transportation, NASA, Interior, the Environmental Protection Agency, Agriculture, Justice, Energy, and Health, Education and Welfare. Only a few States do not have at least one member facility within their boundaries.

The consortium emphasizes the transfer and adaptation of technology through the use of person-to-person mechanisms. The person-to-person element, while not the only important element in the technology transfer process, is increasingly being recognized as one of the keys to successful technology transfer in the area of domestic-sector problem solving. It must be stressed that the consortium activity is in no way intended to supplant or interfere with individual agency technology transfer efforts. It is well recognized that substantial technology has been and is being transferred from Federal civil and military R&D facilities.

The consortium is viewed as a significant piece in the total effort to get the maximum mileage from the nation's investment in research and development. It is designed to stimulate the exchange of information among laboratories and across agency lines as well as between the consortium members and technology users at Federal, State, and local levels of government, and in the private sector.

Organization and Operating Procedures

The consortium is built around technology transfer representatives in the labs and centers. These individuals are assigned by the management of those facilities that have been participating in the system. From these representatives, an Executive Committee is chosen which meets several times a year to assess consortium progress and make recommendations regarding operations and organization. Several years ago, as the number of members grew, it seemed desirable to create regional groupings across the country. Six regions were established, each with a chairman. The Executive Committee is now made up of the consortium chairman, a representative of the National Science Foundation, nine at-large members, and the regional chairmen.

On a day-to-day basis. the consortium responds to queries and requests for assistance addressed to four primary points: the individual laboratory and its technology transfer coordinator; the regional chairman; the consortium secretariat at China Lake, and the program manager stationed at NSF in Washington. At all points, a maximum effort is made to put the inquirer in touch with the most relevant source of help available from the facilities in the system. In support of this purpose, extensive inventories of individual and institutional skills have been prepared and are widely available. In addition, an assistance coordination system called CONTAC (Contact for Technological Application Coordination) makes it possible to reach laboratory specialists who have been designated as the primary contacts in such subject areas as energy, fire, and law enforcement.

Thus the consortium, in its operations, serves as a link between the labs and the user community to: facilitate inter-lab interfaces; broker solutions for Federal agencies; develop coordinated interagency solutions to problems which fall in the areas of responsibility of other Federal agencies; provide an educational forum through the use of educational materials, workshops, guidebooks, etc.; support State and local government programs; encourage Federal agency cooperation; and assist in the commercialization of products.

Selected Consortium Activities

By September of 1973, after only 2 years of operation, the consortium could identify a range of projects which had resulted from Federal agency requests to member labs for technical support. The range of subjects was broad and the amount of funding provided was significant—nearly $19.5 million. The functional areas in which work was being performed included environment, fire and safety, analysis and testing, transportation, law enforcement, health and medicine, and instrumentation.

While it is impossible in a limited space to detail all the technology transfer accomplishments of the Federal Laboratory Consortium in its initial years of operation, it is possible to display a range of achievements. Some of those listed

below reflect the application of particular technologies in specific settings, while others involve institutional modifications or improved processes that offer significant potential for strengthening technology transfer in the longer run. Both are important, and both are emphasized as the consortium evolves.

Included in the broad range of consortium-facilitated achievements are the following:

- Federal laboratories in California joined together into a state-wide consortium to provide direct backup to the California Innovation Group, an 11-city network receiving partial support from NSF. This Innovation Group has used laboratory technology in such areas as night-vision devices, hands-free radios for police officers, tele-conferencing between California mayors and the Secretary of Housing and Urban Development, and the development of soft body armor specifications which have led to the purchase of more than 5,000 garments for police in Innovation Group jurisdictions and other California law enforcement organizations.
- The Army's Edgewood Arsenal, in Maryland, and its Natick R&D Center, in Massachusetts, with Law Enforcement and Assistance Administration funds, developed new and improved soft body armor which is being marketed by a number of manufacturers. It is estimated that more than 50 percent of the approximately 350,000 or so law enforcement officers in our major cities are protected by this armor, and there are 200 documented instances where the armor saved lives or helped to avoid serious injury in calendar year 1977.
- At the request of the Executive Director of the Mayor's Science and Technology Advisory Council, the Frankford Arsenal in Philadelphia designed for the Philadelphia Police Department an optical telescope for determining the firing point of a bullet.
- NASA's Wallops Island, Va., facility has assigned a lab employee on a part-time basis to assist in developing a technology transfer program on the Delmarva Peninsula, which includes portions of the States of Delaware, Maryland, and Virginia.
- A staffer of the Naval Underwater Systems Center in Newport, R.I., assigned as a technology transfer agent to the Connecticut Conference of Municipalities as a part of New England Innovation Group activities, responded in his first year to over 100 requests from local governments in such diverse areas as chemical cost evaluation, aerial photography, photographic equipment, snow and ice control, records management, energy conservation, ultrasonic level detectors, soil mechanics, and infrared scans.
- Technology developed by the Army's Night Vision Laboratory at Ft. Belvoir, Va., has found numerous civilian uses such as: use by the Department of the Treasury in border surveillance, which resulted in the seizure of $19 million

worth of narcotics in one year; detection of illegal aliens; restoring vision of patients in early stages of eye disease; detecting loose rock in mines; night forest-fire fighting by helicopter; prevention of animal poaching; and the study of animal behavior.

- A thermography expert from the Army Cold Regions Research and Engineering Laboratory in Hanover, N.H., and another from the Army Materials and Mechanics Research Center in Watertown, Mass., have assisted the New England Innovation Group as it works to develop the commercialization of thermography and an energy conservation service for public buildings.
- The Army's Mobility Equipment Research and Development Command conducted a water purification project for the City of Duluth, Minn., to remove asbestos fibers from Lake Superior water being used by the city.

An indication of the nationwide interest in Federal laboratory activities in support of local government is the resolution which was passed by the U.S. Conference of Mayors at their 1977 annual meeting. This resolution calls for steps to make it easier for the laboratories to make available their resources in a fashion usable to State and local government. It also endorses the organization of laboratory networks and urges strengthening of the Federal Laboratory Consortium. Finally, it calls for actions designed to better organize the State and local governments to most effectively use laboratory products.

A similar resolution has been passed in recent years by the National Conference of State Legislatures. This resolution states that "the Office of Management and Budget should allocate funds to the Federal laboratories and agencies so that they may utilize their resources for scientific and technical applications in State governments."

The Situation at Present

There appears to be a consensus among knowledgeable persons, both on the Federal side and the State and local sides, that the consortium has been useful in strengthening technology transfer activities. Formal indications of support for the consortium have been provided directly to the National Science Foundation by such agencies as the Department of Defense and the Department of Commerce, and endorsements of the consortium's contributions have been provided to the Office of Science and Technology Policy by other agencies. Thus, it is clear that the consortium, with a relatively small investment of resources, has been useful in increasing the national utility of Federal laboratory products.

If one accepts the proposition that increased domestic-sector use of the resources available from Federal laboratories and centers should be increased (and it is recognized that, at this time, there is not total agreement on this point), two of the questions that must be answered are:

- What steps can be taken to improve technology transfer from Federal civilian sector mission agency laboratories and centers?
- What considerations must be taken into account in using Federal laboratory and center resources to deal with domestic-sector issues that are not within the primary or other specified missions of the department or agency responsible for the facility?

The first point, in essence, deals with the way the agencies with explicit technology transfer mandates, e.g., NASA, DOT, EPA, LEAA, and Agriculture, do their job. Imaginative programs and significant accomplishments among the agencies can be cited across-the-board. Some of these have occurred with transfers to industry and others relate to State and local governmental transfers. However, few would say that the problems of developing a generally effective process of technology transfer have been solved. Progress has been made in the development of new approaches, and agencies with technology transfer charters are constantly striving to make their products and resources more useful to their clients. Those responsible must continuously search for better ways to do the technology transfer job.

The Federal Laboratory Consortium offers one more tool to those Federal agencies that either have a specific charter or an interest in performing technology transfer, particularly in helping them reach user institutions with which they do not have long-standing relationships.

The second point is more complex. It has to do with the R&D facilities of Federal agencies whose primary missions are not related to dealing with domestic-sector issues or whose charter lacks a supplementary technology transfer mission. There are serious problems involved in dealing with technology transfer from such labs and centers. How can the system adjustments be made which would make it possible to maximize the utility of the scientific and technological resources resident in those Federal R&D facilities not directly oriented to the domestic sector, while at the same time ensuring that their primary missions are in no way hindered? The answer to that question requires serious attention if our citizens are to get the most for their tax dollars.

Some of the most severe constraints to be dealt with in resolving the second issue, particularly, are summarized in the aforementioned Council of State Governments report, *The Intergovernmental Use of Federal R&D Laboratories and Centers*. These include:

- The lack of budgeted funds for technical assistance to potential users;
- Statutory restrictions such as the Mansfield Amendment, which places a limit on non-mission (i.e., non-military) related R&D activities by DOD facilities;
- Policy inadequacies whereby the Federal agencies have not developed and promulgated clear positions on technology transfer activities;

- Lack of readily available information on laboratory capabilities;
- Communications difficulties between the facilities and user groups;
- Lack of resources to perform the necessary adaptations to fit technologies to user situations; and,
- Need for a clearer delineation of a point of assistance beyond which the Federal facilities should not go so that undesirable competition with private sector capabilities does not occur.

Attention continues to be given to these constraints and others by the potential user communities, field installations, headquarters-level units, and in the Executive Office of the President and the Congress. For example, representatives of the U.S. Conference of Mayors and the consortium have been meeting with staff members of the U.S. Civil Service Commission to develop position description specifications for technology transfer specialists to establish a career path for individuals working in the field. Agencies are working within present budgetary and policy limitations to assist domestic-sector users. Laboratory resources directories have been prepared to help users find out about the capabilities that exist. Where possible, work has been accomplished to perform technology adaptations with limited incremental resources or with outside funds. Special directives have been issued, such as the Department of Defense ODDR&E letter of 29 June 1976, subject: Non-Defense Work in DOD Labs and R&D Facilities; and DOD Instruction 7230.7, "User Charges." These directives set forth DOD's policy on its laboratories working with State and local governments and the private sector.

While the bulk of the consortium's attention to date has been directed at State and local governments, there has been a sensitivity to the concerns of the private sector. An analysis of NSF's Federal Laboratory activities performed in 1977 pointed out that, from the point of view of industry, a strict adherence to the categories of work allowed under the Office of Management and Budget (OMB) Circular A-97 (rules and regulations permitting Federal agencies to provide service to State and local units of government under Title III of the Intergovernmental Cooperation Act of 1968), and with the policies articulated in OMB Circular A-76 (policies for acquiring commercial or industrial products and services for government use), would be a minimum requirement to avoid undue government competition with private-sector capabilities. The report further stated that there is some feeling in the private sector that A-76 should be revised to be still more strict in limiting Federal work. On the other hand, there is the possibility that detailed analysis of this question, based upon knowledge of the system and experience with technology transfer from the laboratories, could result in a policy that would increase the response flexibility of the Federal laboratories while at the same time leading to even more use of private-sector capacities because of the existence of a more informed and motivated user community at State and local levels. Work is underway at this time on a revision to OMB Circular A-76.

Another relevant OMB Circular is A-109, which establishes policies to be followed by agencies in the acquisition of major systems. One of its sections provides that Federal laboratories may be considered as sources for competitive design concepts. The circular indicates that ideas, concepts, or technologies developed by government laboratories may be made available to private industry through the procurement process or through other established procedures.

The question of laboratory and private organization roles is important. It will continue to be accorded high priority as the consortium proceeds. Further study of this issue is required, and efforts will be made to increase discussion between the public and private sectors, with the overall national interest in mind. For that reason, a search for new ways of achieving increased private-sector involvement in the consortium is a priority emphasis at this time.

Increasing attention is also being paid at high levels within the Federal government to an assessment of the potential for a fuller utilization of Federal R&D facilities and how this might be accomplished. For example, in May of 1978, Dr. Frank Press, Director of the Office of Science and Technology Policy, wrote to nine departments and agencies administering laboratories and centers, asking: (1) for information about the policies applicable to their laboratories and centers working with State and local government; (2) whether the agency felt the need for policy statements regarding an intergovernmental role for the labs, (3) what the effects would be of a formal statement allowing the use of a small percentage of facility budgets for intergovernmental technology transfer, (4) what problems would be foreseen if Federal laboratory support to State and local governments were increased; (5) whether there is a need for improved communications among Federal labs and, if so, should the consortium be the focal point for this? and, (6) are there any significant unresolved R&D management issues in this area and, if so, is there a need for a special interagency examination of them? The staff of the Office of Science and Technology Policy is analyzing the responses to these questions and considering possible future courses of action.

Congressional interest in the appropriate role of Federal R&D facilities was shown in July 1978 when the staff director of the Subcommittee on Science, Research and Technology of the House Committee on Science and Technology sent a questionnaire to selected facilities concerning the utilization of Federal laboratories in technology transfer, including the role of the Federal Laboratory Consortium. The questionnaire inquired about laboratory policy related to technology transfer with both State and local governments and private industry, the priority given to such activities, specific programs undertaken, successful and unsuccessful interactions, the indicated role of the consortium, and steps that could be taken to make lab/user interactions more productive. The response to the questionnaires is included in the committee report on domestic technology transfer completed this

autumn. In its report on the Fiscal Year 1979 authorization legislation for NSF, the committee also indicated that the National Science Foundation should participate more actively in the activities of the Federal Laboratory Consortium and in the technology transfer activities of the Federal laboratories. As another indication of congressional interest and support, it is noted that the Report of the Senate Appropriations Committee on the DOD appropriation for FY 1979 recognizes both the role of DOD in establishing the consortium and the importance of the current DOD policy of authorizing its laboratories to expend up to 3 percent of their professional man-years for this technology transfer effort.

Conclusion

The critical issues are, "How much do we want to change the present situation, and what are the indicated payoffs?" If the potential payoffs to the nation appear to be large enough, a way to accomplish the changes can be found, albeit at a substantial investment of management time.

The standard Federal Government way to address such questions is to assemble an interagency task force and conduct a time-consuming study. Perhaps a more expeditious way to proceed in this instance, since considerable is known already based upon experience to date, would be for the Office of Science and Technology with its Intergovernmental Science, Engineering and Technology Advisory Panel serving as the focal point, to assemble an inter-institutional group of representative Federal agencies, State and local governments, private-sector interests, and possibly others, for the purpose of re-assessing the national domestic-sector potential of Federal R&D facilities. This re-assessment would be undertaken in light of developments since the publication of the landmark analysis highlighted earlier in this paper. If the potential is assessed as high and worth pursuing, the inter-institutional group could: (1) recommend immediate actions that should be taken to increase activity in this area, and (2) describe, and begin to undertake, additional studies to design and develop other strategies that would make it possible for the realization of the potentials that are recognized through a clearly defined action plan with firm assignment of responsibilities and deadlines.

The national investment in Federal Government laboratories and R&D centers is substantial. It has been demonstrated, even without clear and consistent Federal policy in this area, that there is more scientific and technological capability in these facilities of use in addressing domestic-sector issues than is being utilized for this purpose. It is clearly in the national interest to be sure that every effort is made to assess the potential and then to develop means of ensuring maximum realization of this potential in contributing to overall national goals. ‖